R. T. A.

SERVICE MANUAL

RADIO TRAINING ASSOCIATION
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Introduction

This Service Manual was prepared for members of the Radio Training Association of America in order to enable them to intelligently service every type of Radio receiver that is in public use today. It is generally agreed among the Radio Industry that continued successful merchandising is entirely dependent upon the ability to keep the sets that have been sold in working order. This is the field of the Radio Service Man. In every community there are daily calls for radio service, and the service man must be prepared and equipped to handle every type of receiver and to make any kind of repair. Of course, if the mishap is of a more serious nature, it may be necessary to return the receiver to the factory for repairs, but it is up to the sevice man to analyze the receiver and to determine the nature of the trouble beforehand.

A real radio service man is more than a mere repair man, he is an artisan, a technician and a diplomat. As will be brought out in the following pages, frequently when he is called upon to service a radio receiver he must also repair the mental condition of the owner of the set, and this generally requires a highly specialized knowledge of human nature. An all-around radio service man is worth infinitely more to a dealer than a salesman is, for it is simple enough to talk up the qualities of a radio set and often exaggerate just a little bit or more; but it requires super-salesmanship to resell the set to the owner if it fails to live up to all the claims that were made for it by the original salesman. This task falls back upon the service man, and what an interesting job he does have at times.

Also, the service man is practically the only means of contact the dealer retains with his customers; and unless this contact is maintained on a most friendly basis, the dealer will rapidly lose the good will of his customers. A dissatisfied customer is certainly a sore red ink spot on the dealer's ledger.

This service manual will be added to regularly and maintained up to date. Any suggestions or constructive criticisms for improving the book will be welcomed at all times.

Arthur G. Mohaupt

March, 1930

TWENTY GOLDEN RULES

1. Create the right impression—an impression is either favorable or unfavorable, helpful or harmful to your success.
2. Always present a neat and tidy personal appearance, as this does much toward creating a favorable impression.
3. Always be courteous and carry a smile, even though the whole world may appear to be against you.
4. Remember you are at your customer's service, and whenever possible carry out the desires and wishes of your customer.
5. It is very bad practice to enter a customer's home smoking a cigaret. Never smoke on the job—wait till you are through.
6. Always display confidence in your ability to handle the job, and the customer will then have confidence in you too.
7. But be sure you can back up your confidence with the necessary knowledge and skill to do a successful job.
8. Always proceed in a systematic way, do not fumble around in the dark—the customer may be watching you.
9. Do not act hastily—always think before you make a move and have a reason for every move you make.
10. Always be equipped with the necessary tools and test apparatus, it is very bad to have to say you forgot something.
11. Do not spread your equipment over the entire room, decide first what tool you need and when through return it.
12. Do not disturb the furnishings in your customer's home without first asking permission, he may not like it.
13. Never permit the customer to feel that his set is badly damaged—convince him that he still has a good instrument.
14. Always be glad to answer any questions the customer may ask, even though they may have little meaning.
15. Do not enter into idle conversation with the customer, you may say something that he can turn against you.
16. Always keep your employer's interest in mind, his prosperity means prosperity for you.
17. Instruct the customer how to derive maximum pleasure out of his radio, it keeps the set better sold.
18. When a repair job is completed, convince the customer that the set is as good or better than when it was new.
19. Before leaving a job be sure that everything is as tidy as you found it, you will leave a better impression.
20. Always be able to leave the customer's home with the personal satisfaction that you have done the best you can.

QUALIFICATIONS OF A RADIO SERVICE MAN

The Radio service man has today become one of the most important men in the Radio trade. It can almost be said that the future success and good will of the entire industry will depend as well upon his ability to keep the sets sold and working as upon the designers and manufacturers to produce them.

The radio service man as he is needed at present, must be a three-in-one fellow, a repairman, a salesman, and a diplomat. And the man who is proficient as each one of these three can practically write his own pay check. Now what must a man know and be able to do in order to be such a success in Radio?

To be a good radio repair man or radio doctor, he first of all must know radio. He must have a thorough knowledge of radio theory and of the basic principles underlying the construction and operation of radio receiving sets and power units. He must know the laws of electric circuits and how to apply them. He must be acquainted with electric meters and know what combination of instruments to use to make any desired tests. In addition to having this theoretical knowledge, a good service man must be skilled in the use of his hands, he must know how to use a screw driver, pliers, soldering iron, etc. Such skill can easily be acquired by practice and through observing others.

From the practical side the service man must be familiar with all commercial sets in general, and particularly with those handled by the dealer in whose service he is. He must know the nature of the circuit that is employed and the specifications of all the component parts of the receiver, how they function and how they are assembled. In case one of these parts fails, he must know how to repair it, and if necessary how to replace it. If a radio receiver fails to perform as it should, the service man should be able to recognize the symptoms, to judge what the trouble is likely to be and where the fault may lie. It is true that often a set will baffle the highly experienced expert, but ordinarily the defect can be located through a systematic analysis or an elimination process. This practical knowledge also can be easily gained by reading about the experiences of others and through experimental and practice work.

As a salesman and diplomat the radio service man often has his ingenuity taxed more severely than as a repairman. He comes in contact with all types of folks, and must change his tactics, manners and approach every time he rings a different door bell. He meets the "bright chap" who knows just what's wrong and what should be done, but can't do it himself. He meets the pessimist who groans that all is doomed and the set may be quiet forever. He meets the fussy housewife who insists that he come around the rear way and clean his shoes well on the mat. And then again he meets a real human being who just stands by and rejoices when radio harmony is restored.

To be able to handle such a variety of cases and leave each one in a state of good humor, is no small task. It means the service man must know human nature. He must know what to say, when to say it, and when to stop. As a salesman he must resell a set practically every time he calls to repair it.

At the same time the service man must keep himself posted on all the improvements and new developments that are made in the radio art and industry. There are a number of excellent magazines available today that devote the greater part of their contents to radio service problems and practice. Manufacturers booklets and service manuals also are excellent sources of valuable information. Besides keeping posted technically he must also develop new and improved sales talks, and be a constant observer and student of human nature.

THE SERVICE MAN'S TOOL KIT

When a radio service man goes out to answer a trouble call, he never knows what conditions he is likely to encounter. He should, therefore, be equipped with a complete service kit that will enable him to locate any source of trouble and to make minor repairs. Of course, there may be some conditions under which it is necessary to take the radio set to the repair shop or even to return it to the factory, but such cases are in the minority. In order that he can carry out this work in an efficient manner, the service man should be equipped with the necessary tools and accessories, and this equipment should be so complete that it will not be necessary for him to return to his shop for an instrument that is needed. The following list of tools and equipment is suggested. It will be found to be quite complete and of service in practically all cases.

SERVICE KIT

1. PLIERS
   - 1 regular heavy duty pair
   - 1 long chain-nose pair
   - 1 oblique cutting pliers
2. SCREWDRIVERS
   - 1 regular service type
   - 1 long thin cabinet type
   - 1 small short type
3. SOLDERING IRON
   Preferably electric with long cord, solder, flux, etc.
4. METERS
   - 1 high-resistance D.C. voltmeter 0-300
   - 1 storage battery tester
   - 1 dry sell tester
   - 1 A.C. voltmeter (socket plug type)
5. TUBES
   complete set of amplifier, detectors and rectifying tubes
6. Set of socket wrenches for various sizes small nuts
7. Good flashlight
8. Coil of No. 18 rubber-covered stranded wire
9. Insulating tape
10. Set of headphones
11. Strong pocket knife
12. Set and tube tester
13. Circuit tester or Testophone
14. Spudger
15. Fine and coarse emery cloth
16. Assortment of screws and nuts
17. Small flat and round file

The set and tube tester listed as item 12 can be one of the several types that are now being offered by different manufacturers. With the aid of one of these test sets it is ordinarily possible to tell in a few minutes just where the fault in a radio receiver lies or what the nature of the fault is. It is not absolutely necessary to get one of the more expensive ones, for very satisfactory work can be done with the less costly sets. Of course, the larger set testers make it possible to completely analyze a radio in a few minutes.

The Testophone listed as item 13 is the most convenient circuit tester that has as yet been offered. It consists of a single earphone with a built-in battery, and a pair of test points provided with insulating handles and long flexible cords. With the aid of this instrument it is a simple matter to test the continuity of a circuit and to locate a defective coil or burnt out audio transformer, etc. These Testophones are available only through the supply department of the Radio Training Association of America.

The "spudger" listed as No. 14 is merely a bakelite rod ⅜ inches in diameter and about 10 inches long. One end of it is filed down to a screw driver edge while the other has a hooked groove filed into it. With the aid of this device it is possible to adjust balancing or neutralizing condensers, to test the firmness of soldered joinets, or to touch or move connecting wires, for all of which a metalic rod would not do.

THE SERVICE MAN AS A SALESMAN

The service man is practically the only means the radio dealer has of retaining contact with his customers. Therefore, in order to keep this contact as warm as possible, the service man must act as the dealer's personal representative, and at all times take the utmost interest in both the dealer's and customer's good will. If the customer is neglected, he loses confidence in the dealer; and if the dealer's interests are neglected, the business suffers accordingly.

A satisfied customer is the best advertisement a dealer can have, for a customer will tell his friends and these friends will tell their friends. If the dealer demonstrates that he is exerting a real effort to give complete satisfaction, he will be rewarded by the customer exerting effort in bringing more business to the dealer's store. And the only way the dealer can continue to satisfy this customer is by rendering prompt and efficient service in case of trouble. Therefore the entire problem of retaining the customer's good will falls upon the service man. If the service man fails in his mission, the dealer has lost not only one customer but perhaps several. It is much cheaper to retain an old customer by giving him good service than it is to advertise for a new customer.

When a service man calls on a customer to answer a trouble call, he must not only restore the machine to good working order but also repair the mental attitude of the owner. If a radio receiver suddenly ceases to function, the friendly feeling of the owner generally also is bruised; in fact, the service man will often find the customer disgusted and ready to throw the thing out the window. In such cases the service man must be a diplomat and use real ingenuity. He must meet the owner with a pleasant smile and tell him that after all the condition cannot be so serious and that the radio set itself is still a very good one. The owner must politely be told that a radio set is only an electrical machine that has incorporated in it many delicate parts, and that even though the greatest care is exercised in the manufacture and assembly of these parts, one is likely to fail at sometime.

As the service man is thus talking to the customer and gaining his good will, he is at the same time examining the radio and locating the trouble. If he is fortunate to find it a minor one that can easily be corrected, the customer should be shown what the difficulty was and how easily it is corrected. When repairs have been made, the service man should demonstrate that the set is as good as new, if not better. Such procedure will induce the customer to realize that he is dealing with a reliable and dependable organization that is prompted not entirely by selfish motives but that also considers the customer's satisfaction and good will an important asset.

In handling a case in this manner, the service man is more than a mere repair man, he is also a salesman. Where the customer was ready to turn the radio set back, he is now proud of its performance, etc. A man who handles his service calls in this manner is invaluable to the dealer or wholesaler. He is worth more than a mere repairman or than a salesman, he is not only both but an arbitrator in addition.

If the set being serviced is a new machine and the customer has not lost his patience or good humor, the service man can discuss with him the pleasures and entertainment to be derived through having a radio set in the home. He should ascertain the customer's favorite type of program, and then call to his attention the hours at which these programs can be tuned in and the stations that transmit them. Of course, this will make it necessary for the service man to be acquainted with all the chain programs. Anything that will enable the customer to derive more pleasure and benefit from his radio set, will help the cause of radio sales.

PUTTING A NEW SET INTO SERVICE

When a new set arrives from the storage room or warehouse and is to be put into service, the first job is removing it from the crate. If done correctly, this is a comparatively simple task, but if tackled wrong it may prove difficult. One side of the crate is usually marked "Open This Side," and examination will show that this side is held in place by means of a number of nails or screws that are easily removed. There is no need of ruining the crate or any part of it, for the crate has a good salvage value and is readily saleable.

With the side of the crate removed, further examination will show that the entire console is supported on a cross-board that slides on a runner on the side of the crate. In some cases this cross-board is held in place by means of several screws that can easily be removed from the outside of the crate. In other cases there is a cross-piece across the front which holds the console in place. With the screws or cross-piece removed, the cabinet can easily be slid out of the crate. CAUTION—before removing the console be sure to examine the four edges of the crate so that no nail is there to scratch or mar the cabinet. The empty crate should then be nailed up and taken away.

The cabinet is then dusted and the entire surface gone over with a good furniture polish. All traces of powdered pumice are removed, especially in the corners and grooves. Any scratches or spots in the finish should be touched up at once. For this purpose there is available a special burning-in wax that can be had in a number of colors. The colors needed most are light brown, dark brown and red. In addition there will be needed a burning-in knife, liquid white shellac, alcohol lamp, wood alcohol, a felt rubbing block, rubbing oil, fine steel wool and powdered stain of various shades of brown and a green.

To mend a scratch, heat the knife over the alcohol flame and apply a little of the melted wax that best matches the cabinet finish, being sure to make a smooth surface. Then rub it down with the felt block and rubbing oil. If too high a gloss is left, rub lightly with the fine steel wool and then apply the rubbing block again. Any degree of gloss can thus be obtained and the scratch dendered invisible.

For touching up a spot in the finish, some of the powdered stain is mixed with the white shellac. Only a very small portion is needed for a job. If the color appears too red, add a small amount of green stain. After the proper color has been obtained, apply it with a small pencil brush to the spots that need touching and allow it to dry. Then apply a thin coat of white shellac, and finally rub down with the felt block and rubbing oil. With a little experience it will become an easy matter to so blend in touched up spots that they will hardly be noticeable.

The receiver is now ready for electrical inspection. Check all the cords leading from the set to the speaker and power pack and tighten any that may be found loose. Also check the speaker and see that all bolts and screws are tight, for some may have worked loose during shipment. Inspect the control knobs and tighten them securely to the shafts. Then insert a set of tubes, connect aerial and ground, and put the set into operation. If any defects show up, correct them at once. Frequently a new set will require rebalancing or aligning of the condensers. The volume control should be examined carefully for any rough spots. Another condition that is found occasionally is that the condenser shaft is loose in the drum dial, or that the dial indications do not coincide with the condenser settings. Cases have been found where the drum dial touches the cabinet at one extremity of the turn. A thorough examination and try-out may save the expense of a service call after it has been installed in the customer's home. Furthermore, if something does go wrong so early with a newly installed set, it is likely to leave a bad taste with the customer.

INSTALLING A NEW RADIO RECEIVER

After a customer has purchased a radio receiver, he is generally very enthused about it and is anxious to see and hear the set in his own home. Therefore, when the set is being delivered, the service man should also display great interest in the receiver so that the customer's enthusiasm will not be allowed to cool off in any way.

When the set is being carried into the home, the greatest care should be exercised that nothing is scratched or bumped and that no dirty tracks are left behind. In a polite and courteous way the customer should be asked where he would like to have the set placed; and if it is not very convenient for the installation connections, it might be permissible to suggest in a very diplomatic manner, a more desirable location. The service man should size up the entire room and then suggest a location where the set would fit in best with the general layout and at the same time be sufficiently conspicuous. If it is necessary to move a chair or other article while doing the work, the customer's permission should first be asked; and when the job is completed, everything should be returned to its place.

As to the aerial and ground connections, these depend upon the individual requirements. Although an outdoor aerial is most desirable in any case, in many instances an indoor aerial serves equally satisfactory. For example, in an apartment building on the upper floors, a wire concealed behind the picture molding will give very good reception. However, experience has shown that in rooms in which metal laths are used, the metal acts much like a shielding screen and but little reception will be received. In such places, an outdoor aerial is almost essential. Another good form of indoor aerial is a wire spread under the rug of the room. A special thin loop wire is available for this purpose so that no breaks will be caused by the wire in the fabric of the rug. For the ground connection, a wire can be run to the nearest radiator, but care should be taken that all paint and enamel are removed and that good contact is made with the bare metal. Of course, if connection can be made conveniently to a cold water pipe, this is always more desirable.

Very successful reception can be obtained in many installations by using the electric light wires as an antenna. Special antenna plugs are available for this purpose that can be plugged into any convenient outlet. However, never should the use of the light wires as an antenna be attempted with only an ordinary plug and attached wire.

After the installation has been completed and all tools and other paraphernalia have been picked up, the receiver should be given a rigid test to see that all stations can be tuned in as they should appear and that the volume control and other parts are functioning correctly. If everything proves satisfactory, the customer should be called in and given instructions in how to tune and operate the set. The customer's favorite type of program should be ascertained, and he should then be told at what time and over what stations these programs can be heard. This means that the service man must be well acquainted with the complete series of chain programs. Showing the customer how to derive maximum pleasure and benefit out of his radio receiver will insure his being more satisfied and enthusiastic about his purchase. And a satisfied customer is the best asset a dealer can have.

After three or five days, another call should be made at the customer's home to inquire if everything is operating perfectly satisfactorily; and if it is not, corrections should at once be made. Such a call will convince the customer that a real interest is being taken in him and he will as a result have greater confidence in the dealer. This is also an excellent time to obtain from the customer the names of some friends neighbors who also might be interested in a good radio set.

ANTENNA INSTALLATION

The successful performance of a radio receiving installation depends to a great extent upon a good antenna and ground system. Even though apparently satisfactory results may at times be obtained with make-shift arrangements such as a short piece of wire thrown on the floor or fastened behind a picture, superior results are always obtained with a good standard outdoor antenna.

For most satisfactory broadcast reception an outdoor aerial should always be recommended wherever conditions permit. The antenna itself should be from 50 to 75 feet long, and the lead-in should be kept within a reasonable length so that the combined length of the aerial and lead-in will not exceed 125 feet. A single length of wire (solid or stranded) stretched between two rigid supports serves excellently. It should be insulated at each end with a glass ar porcelain insulator so as to avoid any leakage of the small amount of energy that accumulates on it. The wire should be stretched tightly so that it cannot sway with the wind, for any swaying causes noises in the receiver output. The horizontal part of the antenna should be as high as possible, and not close to metal roofs, walls, trees, power wires, etc. In congested city districts, it may be necessary to use a shorter antenna in order to secure greater selectivity, but in rural districts there is no need for any such limitations and greater lengths can be used as desired. Greater antenna lengths mean more volume, but also a greater accumulation of static, etc. Tuning also is broader.

The lead-in serves to connect the antenna proper with the receiving set. The best arrangement is to have the antenna and lead-in one continuous wire; but if this is not possible, the connection between the lead-in and antenna should be soldered and taped so that permanent electric contact is established. The lead-in should be kept away from all electric wires and grounded objects. Where it enters the building a porcelain tube should be used or an approved window lead-in. No. 15 or 16 rubber covered wire is recommended so as to keep the resistance as low as possible. If the lead-in is very long as from the roof to the first floor of a 2 or 3-story building, then the wire should be anchored at several places so that it cannot sway. Also, it should be installed so that it will not be too conspicuous or mar the appearance of the building.

A good ground connection is just as essential as a good antenna. A high resistance ground will cause broad tuning and often noisy set performance. The ground wire should be as short and direct as possible. The ground should preferably be made to a cold water pipe. A radiator will serve as a fair substitute, but it is not so desirable because frequently there is a rubber or composition gasket somewhere in the pipe line that serves as a blocking insulator. Connections to gas pipes are to be avoided, as these are not at all satisfactory and also involve some fire hazard. In rural communities where no pipe system is in the house, a ground connection can be established by driving an iron rod or pipe at least five or six feet into the ground. The main point to keep in mind is to keep the ground resistance at a minimum.

In cases where it is impossible to erect an outdoor antenna, the only solution is an indoor antenna. If it is a frame house with an attic, the antenna can be supported by means of insulators from the rafters. To get a sufficient length of wire, the antenna can be stretched in a rectangular or zig-zag fashion. Such an attic antenna will generally give as satisfactory results as an outdoor wire, especially if the proper length of wire is used. Where there is no attic, the next best thing is a wire placed around the picture moulding in the room where the set is to be used.

MAKING A SERVICE CALL

A radio service call is a visit to a balky radio set, and frequently the owner's temperment also is severely strained and needs correction. Therefore the service man should make his appearance with a pleasant smile, and bring in a few words of good cheer whenever they might be needed to relieve the tension. He should be courteous and polite, and very discreet in the choice of his conversational remarks.

As soon as he has been admitted into the home and has had the opportunity to express his friendly "good morning" or "good afternoon, Mrs. Brown," he will be shown to the radio set, and invariably the owner will at once begin explaining what the set does or does not do. Although it is not good policy to put the customer through any extended cross examination, still often valuable information can be gained by asking him a few questions regarding the receiver, such as, have the tubes been tested recently, were any changes made in the set or tubes, was the set moved around in the room, etc.

When the desired information has been obtained, the service man is ready to begin work. Often he can tell from the answers just what is wrong, locate the trouble, and make the necessary repairs in a few minutes. Other times it will be necessary to make quite a thorough analysis of the receiver. If this analysis reveals that the trouble is of a more serious nature, the owner should be informed what the cost of the repairs will amount to. In any case, the work should always be done in a careful and systematic manner, especially for the sake of the psychological effect it has on the customer. He will have greater confidence in the abilities of the worker, and the mental healing effected in this manner will help greatly toward accepting the repaired job with a feeling that the set works as well or even better than it did formerly.

Some repairs can be made directly on the customer's premises, while others will necessitate taking the chassis back to the shop. The service man himself must really decide which is the best thing to do. If the job can be done conveniently at the customer's home, it is most desirable to do so, for it will cause least delay in the customer's use of the radio set. Also, taking the chassis to the shop necessitates a second trip and this greatly increases the cost of the repair job. On the other hand making a major repair on the premises may have a bad effect on the owner, for he is likely to believe that he received an inferior or defective set to start with.

If the repair is made at the customer's home, the service man should proceed in a neat orderly fashion. He should avoid scattering his tools and other equipment over the entire floor. Likewise in removing the chassis from the cabinet or console he should be careful not to scratch or mar the wood finish. When the job is completed and the chassis returned to the cabinet, everything should be picked up and cleaned away so that no untidy remnants are left behind.

After the set is in good working order again, the owner should be called in and shown that all corrections have been made and that everything is functioning properly. Any questions should be answered cheerfully. When the customer has finally expressed his satisfaction, the service man is through.

If a chassis is taken to the shop for repairs, it should receive prompt attention and be returned to the owner as quickly as possible. If a delay is necessary on account of replacement parts having to be ordered from the factory, the owner should be advised at once so that he will not become impatient and make things doubly unpleasant when the service man returns.

NOISES IN A RADIO RECEIVER

Noises in a radio receiver may be due to external interference or to a faulty condition within the set itself. In the former case they may not be so easy to eliminate, but in the latter the problem should not be difficult. To determine the nature of the noises, disconnect the aerial and ground, and if they disappear, they were picked up from some outside source. But if they persist, they originate within the receiver, or in the case of an electrical set they come in over the electric light wires.

External noises may be due to a faulty antenna-ground system or may be caused by some near by electrical installation. Start with the ground terminal on the set and carefully trace the wire to the point where it is grounded. If the wire is an insulated single conductor, be sure that there is no break in it, for often the insulation completely conceals such a break. Also, the connection to the ground pipe should be electrically secure. If a radiator or steam pipe is used as a ground, try changing to a water pipe to see if the noises disappear. It may be that the threads on the pipe are rusted badly and thus introduce a variable high resistance which causes the noises.

The best form of antenna system is one in which the antenna and lead-in form a continuous wire. If the lead-in is soldered to the antenna, inspect this joint carefully, for the solder may be badly corroded or broken away. An unsoldered joint is not at all satisfactory and should never be used. Properly clean the insulators supporting the antenna so that an accumulation of dirt, soot and moisture can not cause leakage. Next examine the lead-in, as this may be rubbing against the building or tin gutter or fire escape and be grounded there. At such points the wire should be protected with porcelain insulating tubes. It might also be that the wire while swaying in the wind was broken and that this break is concealed by the insulation. If a window lead-in or similar device is used, this should be examined for worn insulation or grounded spots.

Should the noises arise within the set, a close inspection of all wires leading to and from the set should be made, for often a loose or broken wire may be the source. If possible, substitute another speaker to make sure that the noise is not there. Finally make a thorough inspection of the entire wiring system within the set. All soldered joints and connections should be examined to see if they are secure. A bakelite or hard rubber rod is very handy for this purpose. Should a loose contact exist, grating noises will be heard. Often a soldered joint that appears to be firm has crystallized or has a layer of rosin underneath, and the result is a high resistance or poor contact.

With battery operated sets the noises frequently arise in the batteries, especially the B-battery. If one or more of the individual cells of a B-battery becomes dry, the internal resistance increases greatly, and since this resistance varies considerably it causes changes in current flow and hence noises in the receiver output. The performance of B-batteries is always greatly improved by connecting a 1-mfd. bypass condenser across them. This condenser acts as a reservoir and tends to smooth out the current pulsations. If the terminal voltage of a 45-volt battery drops to 35 or less, it should be discarded and replaced by a new one. This terminal voltage must be measured while the battery is in use, for a reading taken after a battery has been standing idle for several hours has no meaning. The same applies to dry cell A-batteries. Storage batteries are also likely to become noisy if they are neglected.

SERVICING A BATTERY OPERATED RECEIVER

A radio receiving set, like any mechanical or electrical device, is likely to go wrong or to cease to function some time; and when such an occasion does arise, the trouble can always be located in minimum time and with least effort by following a definite routine and systematic analysis of the entire installation. The following procedure is suggested for battery operated receivers.

1. INSPECT TUBES. If tubes do not light, look for: dead A-battery, broken wire within set, dry cells not connected correctly, defective rheostat, burnt out tubes, or poor contact between socket and tube prong.

If tubes light but no sounds are produced, look for: dead B-batteries, wrong B-battery connections, broken speaker cord, paralyzed tubes, poor socket contacts, shorted phone or speaker condenser, open plate circuit, burnt out audio transformer, or burnt out speaker.

2. TEST TUBES. To test tubes place them in a standard tube tester and observe the plate emission as indicated by the milliammeter in the plate circuit. Also look for shorted elements within the tube. If the plate current is weak, the tube probably can be revived by rejuvenating it; but if the tube is entirely exhausted, then it is best to discard it and replace it with a new one. Always test a new tube before attempting to use it.

3. CAUSES OF WEAK SIGNALS. When signals are weak, look for: exhausted A or B batteries, reversed A-battery connections, reversed or weak C-battery, poor socket contacts, defective audio transformer, short-circuited speaker condenser, defective or wrong size grid leak, poorly soldered or crystallized joint, dust or dirt between condenser plates, open or reversed transformer, or paralyzed tubes.

4. CAUSES OF DISTORTED SIGNALS. If signals are of proper strength but distorted, look for: wrong plate voltage in detector tube, improper voltage or grid bias on amplifier tubes, defective audio transformer, poor socket contact, poor or high-ratio transformers, overloaded output tube, reversed transfomer connections, defective or improper grid leak, improperly placed audio transfomers, oscillations in radio frequency amplifier, too many stages audio amplification, or a paralyzed audio tube.

5. CAUSE OF SQUEALS AND WHISTLES. Whistling and howling are more generally due to some improper adjustment or circuit arrangement than due to a defect or fault of some kind. Look for: oscillation in radio frequency amplifier, excessive plate voltage on detector or R. F. tubes, too much regeneration in detector circuit, too high filament voltage, incorrect size grid leak, disconnected aerial, open grid circuit in R. F. amplifier, defective grid condenser, audio transformers too close, wiring within set poorly placed so that inductive coupling results, or reversed audio transformer connections.

Another common cause of unpleasant howling is a microphonic tube, that is a tube in vibration. This may be caused by a defective tube or due to air vibrations from the speaker setting the tube into vibration. To locate a microphonic tube, grasp each tube firmly until the one is located that is causing the noise. Often placing the tube in a different socket will remedy the condition. Also try changing the position of the loud speaker. Never place the loud speaker on top of the radio set.

Howling may also be caused by the loud speaker cord lying too close to or on top of the audio transformers. Always have the speaker cord extend out of the cabinet and away from the set as directly as possible.

SOME COMMON SERVICE COMPLAINTS

The following four service complaints are frequently encountered; and if the suggested sources of trouble are checked, it generally will not be a difficult problem to remedy the condition. In most cases the trouble will be found to be in the accessories rather than in the set itself, especially if the receiver formerly worked all right.

1. NOISY OPERATION—generally due to external interference picked up by the antenna or a faulty condition within the set. The trouble may be:

A. Faulty antenna or ground—look for loose joint, broken wire, contact with some grounded object, poor lead-in connection.

B. Loose connection—look for loose plug in electric outlet, examine cord and contacts, check entire receiver wiring for loose contact or poorly soldered joint, look for defective socket or switch in house lighting circuit. Jarring the cabinet will generally reveal if the loose contact is in the receiver.

C. Noisy tube—look for defective tube, especially in the detector or rectifier stages.

D. Noisy condenser—look for touching plates, dirt particles between the plates, or loose pig tail. Clean condenser with ordinary pipe cleaner.

E. Excessive A.C. hum—look for a grounded filament lead, an open or shorted center-tapped resistor, a punctured bypass or filter condenser, an open grid bias resistor, or incorrect plate voltages.

F. Static—manifests itself as irregular crackles and crashes. It is an atmospheric disturbance beyond control. Often external electrical interference is wrongly termed static.

2. POOR SELECTIVITY—the inability to tune in one station without interference from other stations, and may be due to a faulty condition in the radio installation or to overcrowded air conditions. Such "broad tuning" may be due to:

A. Incorrect antenna—antenna may be too long or mounted too close to a metal roof, large trees, or electric wire system.

B. Leaky antenna system—the accumulation of dirt or soot and snow or ice may cause leakage to ground, keep insulators clean and prevent grounding contact. Also look for defective lightning arrester.

C. Defective tube—replace each tube in turn with a known good tube.

D. Nearby powerful station—the receiver may be under the blanketing influence of a nearby station with a broad transmitted wave. Try a wave trap.

E. Condenser alignment—gang tuning condensers may have been adjusted incorrectly and tampered with and are in poor alignment or out of balance. Do not attempt adjusting until certain this is where trouble lies.

F. Poor or high resistance ground.

G. Improper B voltage or incorrect grid bias, or too much regeneration suppression.

H. Harmonics—the appearance of a station at several dial settings due to transmitter sending out more than one wave length and cannot be corrected by adjustment on receiver.

I. Heterodyning—whistling and squealing caused by interference of two stations operating on nearly the same wave length, generally distant stations. This condition cannot be overcome with any receiver.

SOME COMMON SERVICE COMPLAINTS

3. POOR TONE QUALITY—poor sound reproduction may be caused by a faulty condition in the audio amplifier, by a poor loud speaker, or by poor broadcasting. Look for the following:

A. Defective power tubes—the most common cause of poor tone quality. Result may be rattles in speaker, decrease in volume, and absence of bass notes.

B. Defective amplifier or rectifier tube—a defective radio or audio amplifier may cause distortion. Poor rectifier tube may limit the available voltage.

C. Low plate voltage on amplifier tubes—cause of mushy and scratchy tones. Check voltages on each tube.

D. Improper C-Bias—due to open or shorted biasing resistor or resistor of incorrect value. Tones are flat and distorted.

E. Poorly matched tubes in push-pull amplifier.

F. Transformer primary partially shorted, secondary winding grounded, or leakage between primary and secondary of output transformer.

G. Transformers too close, or speaker cable too near to transformer.

H. Defective speaker—speaker may be of poor design, out of adjustment, or in defective condition. Check against speaker known to be in good condition.

I. Free oscillations—indicated by squealing and distorted tones, most noticeable at the higher frequencies. Balance R. F. amplifier. If screen grid tubes are used, look for defective tube, open bypass condenser or poor grounding of shields.

4. WEAK RECEPTION ON DISTANT STATIONS. A receiver lacking sensitivity may give good volume on local stations but will have a very limited distance range. The cause may be due to one of the following conditions:

A. Inefficient antenna—antenna may be of improper length for receiver on hand. Also look for broken wire, corroded joint, dirty insulators, contact with grounded object, defective lightning arrester, or poor connection.

B. Poor tube—a weak tube may render a set insensitive. Check all tubes and replace any defective ones.

C. Incorrect voltages—check all filament and plate voltages, also test line voltage. Observe if amplifier tubes have proper grid bias.

D. Condenser out of alignment—ganged condenser out of mechanical and electrical alignment will impede weak signals. Check and align condensers.

E. Receiver not balanced—unbalanced R. F. amplifier causes poor reception and interferring oscillations. Check and balance the receiver.

F. Defective volume control or poor contact—check entire receiver and speaker for poorly soldered joint or defective resistor.

G. Fading and static—two atmospheric conditions beyond control. Cannot be corrected by adjusting receiver.

H. Location—local conditions often affect reception, especially in congested metropolitan districts. These conditions cannot be corrected by adjusting receiver. Interference from a local station may also suppress a distant station.

ALIGNING A RADIO RECEIVER

Unless the sucessive stages of a R. F. amplifier are in exact synchronism (tuned to the same frequency for every dial setting), the receiver will lack volume, specially on distant stations. On strong local stations tuning will be broad.

Lack of synchronism between these successive tuned stages may be due to two causes, in accuracies in the condensers or coils and stray capacities due to the different lengths and positions of the connecting wires. To compensate for these unbalancing factors that affect the tuning of each individual circuit, the main tuning condenser is provided with small auxiliary condensers connected in shunt with each stator and rotor section. These compensating or aligning condensers as they are called, can be adjusted with a screw driver or socket wrench. In the case of completely shielded receivers small holes are provided in the shielding to make them accessible. If these holes cannot be located, the instruction book or service sheet should be consulted for their location.

Some receivers can be aligned by leaving the chassis within the cabinet or console, but in other cases the chassis must be removed. A set of standard tubes is put into the receiver, and a modulated oscillator is again employed and placed close enough to the receiver so that its note can just be clearly distinguished in the speaker. The tuning dial is then set for about 1200 kilocycles, and the condenser on the oscillator adjusted until the note is clearly heard.

For aligning begin at the compensating condenser next to the detector and adjust it until the loudest sound is produced. Then do the same with second condenser section, the third, etc. By exercising a little painstaking care the receiver can easily be brought into perfect alignment. However, the main tuning setting must not be changed during the aligning process, for otherwise the entire job must be repeated.

If no oscillator is on hand, the signals from a local broadcasting station operating at a fairly high frequency can be used instead.

Instead of depending upon the ear to determine when the loudest signal is being emitted during the aligning process, it is also possible to obtain a visual indication by using an electric mater in place of the speaker. A Weston Model 425 thermogalvanometer is specially suitable for this purpose. A convenient arrangement to use is a double-pole double-throw switch from the middle terminals of which a pair of leads are connected to the speaker terminals on the radio set. The speaker is then connected to one side of the switch and the meter across the other side. By throwing the switch to one side or the other either the speaker or meter can be used. When the meter test is being used, the oscillator should be moved to such a distance from the receiver until a meter indication of about 20 points is obtained before any adjustments are made. The compensating condensers are then adjusted until maximum meter reading is obtained for each stage.

Care should be taken in carrying out the above adjustments that the operator's hands as well as other parts of his body be kept well away from the condenser sections and coil units, for their presence will introduce sufficient capacity to affect the tuning of the respective circuits. Likewise, do not attempt to use a balancing wrench which is not made of good insulating material, because too much body capacity will again be introduced. When the best setting for a condenser section appears to have been found, remove the wrench, and if the volume remains the same, it is evident that the setting is correct. But if the volume changes, then body capacity effects were present and the condenser sections are not properly aligned. If the chassis being worked on is a completely shielded one, it is very important that all shields be in place (including the shield over the balancing tube) before any balancing or aligning operations are attempted.

BALANCING A RADIO RECEIVER

Radio frequency amplifiers of the neutrodyne or R. F. L. type employ a group of small adjustable condensers known as neutralizing or balancing condensers, the function of which is to balance the plate and grid circuits against each other so as to eliminate self or free oscillations. Unless these neutralizing condensers are set correctly, the radio frequency amplifier will squeal and howl. The tones will also be distorted, and the sensitivity greatly reduced.

Ordinarily a receiver is properly balanced at the factory and seldom need these adjustments be touched. If undesirable oscillations or excessive regeneration do persist, one of the following conditions may be the cause: defective R. F. amplifying tube, excessive plate voltage, improper grid bias, stray coupling between R. F. units, poor ground connection, shorted grid suppressor or too little resistance in suppressor, and open or lack of bypass condensers. A defective tube can readily be detected by replacing the tubes one by one with a known good tube; the plate voltage and grid bias can easily be checked with suitable meters; stray coupling can often be eliminated by changing the position of one or more wires or by moving one of the coils; the ground connection can quickly be inspected; the grid suppressors can easily be tested or replaced by some of higher resistance, and the bypass condensers can also be tested and additional ones inserted so as to properly bypass the energy that is causing the unnecessary regeneration. Only after all other conditions have been checked and found to be OK, should rebalancing be attempted.

The materials needed for neutralizing a receiver are a modulated oscillator, a balancing wrench and a balancing tube. The balancing wrench consists merely of a bakelite or fibre rod provided with a square or hexagon nut on one end to fit the caps with which the neutralizing condensers on the receiver are provided. The balancing tube is a normal 227 tube (201A tube for battery operated receivers) with one of the filament prongs cut off. This tube should be handled carefully and not dropped or jarred.

To balance or neutralize a receiver, the chassis is removed from the cabinet if necessary and provided with a set of standard tubes. The plug is inserted into the light socket and the oscillator terminals connected to the antenna and ground binding posts. The tuning dial is then set for about 1200 kilocycles, and the oscillator condenser adjusted until the signal is heard clearly in the speaker. The receiver volume control should be turned full on, and the oscillator kept at a fairly good distance and adjusted so that enough energy will be emitted to produce a good audible signal in the loud speaker.

The last radio frequency tube, the one just ahead of the detector, is now removed and replaced with the special balancing tube. Next adjust the corresponding neutralizing condenser until the signal in the speaker is at a minimum or disappears entirely. A little practice may be required until the correct point is found, but by turning the wrench back and forth slowly the place where the signal fades away will soon be located. Lastly the proper tube is returned to the socket and the tuning condenser readjusted for maximum signal strength.

The next radio frequency stage is then neutralized in the same manner. The regular tube is replaced with the balancing tube and the balancing condenser adjusted until the signal disappears. The proper tube is returned to its socket and the tuning condenser readjusted for maximum signal strength. The same operations are repeated for each additional radio frequency stage until the entire receiver is neutralized. It may be a good idea to repeat the whole process so as to make sure that all adjustments are absolutely accurate.

CONTINUITY TESTING

A continuity test is a test for ascertaining whether a circuit is open or closel, or for approximating its electrical resistance. Such a test when applied to the various circuits of a defective receiver will quickly reveal the cause of the trouble if it is in the form of a broken wire, an open coil, or an open or shorted resistor.

A convenient continuity tester can be made by connecting a Jewell 0 to 1 D. C. milliammeter type 54 in series with a 10,000-ohm resistor and a 9-volt C-battery, and terminating the circuit with two flexible test leads. When the two test points are touched together, the meter will indicate approximately full scale deflection. The same will be true if the test points are connected across the terminals of a circuit in which the resistance is very low or it is shorted entirely. On the other hand, if the circuit being tested is open, no current at all will flow through the test leads and the meter will give no deflection.

If the resistance of the circuit under test is relatively low, say up to 1000 ohms, the meter deflection will be between three quarters and full scale deflection. As the resistance of the circuit increases, the meter deflection becomes less; and at extremely high resistance values the meter deflection will be but a slight movement of the pointer. Hence, when the test points are put across the terminals of the circuit under question, the meter not only will indicate whether the circuit is open or closed, but it will also give the operator an idea approximately what the resistance of the circuit is. This information will at once enable him to decide if the circuit is in proper working order.

The continuity tester can also be used for locating faulty or defective bypass condensers. If the test leads are applied across a small bypass condenser, the meter will give no reading providing the condenser is in good condition. But if the condenser is punctured and shorted, the meter will register full scale division; while if the condenser is leaky but not completely shorted, the meter will give a deflection depending upon the resistance of the circuit.

To illustrate an application of continuity testing, assume there is on hand an A.C. set using tubes of the 227 or 224 type in the R.F. amplifier, and preliminary test shows no grid bias on some of the radio frequency tubes. Analysis of the circuit will reveal that the cause can be only an open or ungrounded grid bias resistor, an open grid return, or a shorted bypass condenser.

To check the grid bias resistors, apply the test leads across each one, and if the meter shows one of them to be open (no pointer deflection) replace it with a new one. To determine if any bias resistors are ungrounded, apply the test leads to the resistor and the grounded frame or chassis. If no deflection on the meter shows one of the circuits to be open, look for a poorly soldered joint or a broken wire and repair it. If one of the bypass condensers is suspected, disconnect one of its terminals and test it as suggested above. To see if there is an open grid return, apply the test leads to the control grid terminal of the socket and the grounded frame or chassis. If the meter fails to indicate a closed circuit at any one stage, it is evident either that one of the coil secondaries is open or that there is a poorly soldered joint, a broken wire or a wrong connection. In this manner the continuity test at once reveals where the fault lies in the circuit system. The same continuity test method can be applied also to the audio amplifier, the power supply pack, or any place where a broken or shorted circuit is suspected.

An important point to observe when making a continuity test is to disconnect the receiver from the source of power and from the aerial and ground, otherwise the results may be very confusing.

TROUBLES IN A.C. ELECTRIC SETS

The following is a summary of the more common troubles and their causes that are experienced with A.C. electric receivers.

A.C. HUM. All A.C. sets emit a slight hum that is inaudible at a distance from the speaker; but if one is noticeable, some faulty condition exists.

1. Hum adjuster out of balance.
2. Defective detector tube. Check by substituting a good tube.
3. Defective power tube with an open grid or shorted grid to filament. Check by substituting good tube.
4. Unmatched power tubes in push-pull audio stage.
5. Open grid bias resistor or shorted grid bias condenser. Either condition will cut out the grid bias from the tube. (In 5, 6 and 7 apply continuity tests).
6. Grid bias resistor ungrounded. This also cuts out grid bias.
7. Grounded filament circuit in power stage. This cuts out grid bias and causes hum.
8. Defective center tap resistor. A resistor with an open side or uneven sides causes an unbalance and creates a hum.
9. Open or ungrounded center tap on transformer. Use continuity tester to check transformer as well as the lead from transformer to the terminal strip or ground.

NOISY OPERATION.

1. Loose contact or corroded joint within the set.
2. Defective or noisy tube or poor contact between tube prongs and socket clips.
3. Poor contact with speaker terminals or defective speaker cord.
4. Faulty antenna or ground—loose joint, broken wire, contact with grounded object, poor lead-in connection.
5. Defective switch or socket in house lighting system or loose plug-in electric outlet.
6. Noisy condenser due to dirt particles between plates, or loose pig tail connection.
7. External interference picked up by antenna.
8. Static—an atmospheric condition beyond control.

WEAK SIGNALS.

1. Inefficient antenna system—improper length wire, broken wire, or poor contact, or defective lightning arrester.
2. Defective or exhausted tubes.
3. Incorrect plate or grid bias voltages. Line voltage may be high or low, or faulty condition in power pack.
4. R.F. amplifier unbalanced or gang condenser out of alignment.

FADING SIGNALS.

1. Variations in A.C. line voltage.
2. Defective detector or power tube.
3. Fading due to atmospheric conditions.
4. Poor connection in filament supply.

FAULTY POWER SUPPLY UNIT.

1. Faulty power transformer.
2. Punctured Condenser.
3. Burnt out resistor.
4. Defective rectifier tube.

OSCILLATION

1. R.F. amplifier unbalanced or gang condenser out of alignment.
2. Defective R.F. amplifier tube—check with good tube.
3. Ungrounded receiver. Some radio receivers become unbalanced without a ground or with a high resistance ground.
4. Antenna too short. A very short antenna absorbs energy from the grid circuit and thus causes the R.F. amplifier to oscillate.
5. Lack of shielding. All shields must be in their places.
6. Grid resistors open or of too low resistance.
7. B-voltage too high or screen grid voltage too high.

SERVICE PROCEDURE ON A.C. RECEIVERS

The following method of procedure is suggested when you are called upon to service a radio receiver that for some reason has ceased to perform properly. It was previously stated that often the customer's remarks or explanation will point directly to the source of trouble, but geneally it will require more or less of a diagnosis in order to locate the defect. It is quite important that a systematic course or plan be followed in such cases, for otherwise much valuable time can be wasted, and often the trouble will be found to be some trivial matter that at first did not even receive consideration.

Begin the diagnosis by examining the tuning control and looking for a scraping dial, a binding cord, or a slipping contact on the condenser shaft. Then examine the volume control for scraping noises or undue looseness. After you are satisfied that all the controls are O.K., turn on the receiver. If the receiver remains dead, examine the wall outlet and the attachment plug, and with a plug-in meter, check the outlet voltage. Next look after the "off-on" switch in the receiver, for this may be defective. Lastly examine the input circuit for a broken lead or open connection and test the continuity of the primary winding of the power transformer. If this is open, a new transformer is needed.

If all the tubes light except one which appears to be burnt out, try it in another socket to see whether the tube or socket is at fault. If all the tubes light, but it is suspected that one or several are defective, tap each tube lightly to see if any elements within the tube are touching. Such a condition will manifest itself by a bad rattle in the speaker or by allowing reception to come through for a few seconds. Then replace each tube in turn with a known good tube until any defective trouble makers have been replaced. In the case of screen grid tubes be sure that the top cap connections are making good contact. If all tubes are found to be in good condition and the receiver still fails to perform correctly, it is evident that something is wrong internally, or that the fault may lie in the accessories.

If the set appears to be weak, check the antenna and ground connections, and especially each end of the window lead-in strips if any are used. Also observe the lightning arrester, and if you are suspicious about it, take it out of the circuit entirely and note if any improved results are obtained. If another speaker is available, try it to see if the fault might be in the speaker. The causes and remedies for such defects as noisy operation, poor selectivity, poor tone quality or weak reception on distant stations are given on other pages.

After all the above tests seem to indicate that the tubes, antenna, etc., are all right, the radio frequency amplifier can be further checked by means of a series of simple tests. The antenna wire is disconnected from the antenna binding post and touched to a series of points further along in the electrical circuit. In this manner, any defect in the R.F. amplifier can be quickly isolated. The points that can be reached conveniently, of course, will depend upon the circuit arrangement and the mechanical construction of the receiver. For example, if the antenna wire is connected to the plate terminal of the first R.F. tube and satisfactory reception is at once secured, it is evident that the trouble lies between the antenna binding post and the first R.F. tube. If no reception is obtained, the antenna wire is moved further along, the most convenient point being the plate terminal of the second R.F. tube. If tubes of the screen grid type are used, the antenna wire can be touched directly to the control grid contact at the top of the tube. As soon as reception is received, you know that the trouble must lie directly ahead of the point under test.

CIRCUIT TESTS IN A.C. RECEIVERS

An inspection and analysis of A.C. receivers will reveal that all are fundamentally alike in one respect, in that all circuits return to the ground or neg. B line, which is also grounded to the metal chassis. That is, the neg. B line forms a starting point from which the continuity of nearly all circuits can be tested.

For example, the plate terminals of the sockets are connected through their respective windings to the B-power supply and through the filter to the rectifier tube filament. The grid terminals are connected through their windings directly to the neg. B or ground, except in the case of the detector tube the circuit continuity is interrupted by the grid condenser . The filament terminals are connected to the transformer secondary, and from the center tap of this winding or from a center-tapped resistor they are connected through a biasing resistor to the neg. B line. In the case of the detector there is no biasing resistor, and the cathode connects directly to ground, except with a power detector and here a biasing resistor is used between the cathode and the ground.

With these facts known, it is an easy matter to test out a receiver. First test the R.F. stages for continuity from the grid terminals of the sockets to ground, and in the case of the detector from ground to the corresponding condenser stator plates. Complete continuity should also be obtained from the rectifier tube. Then in like manner, test for continuity from the grid and plate terminals of the audio sockets. Lastly, test each pair of filament terminals to ground or frame of the receiver, and also ground to detector cathode.

For proper interpretation of results, it is necessary to consider also the resistance of the circuits. In the R.F. plate circuits, the resistance includes the filter chokes of the voltage divider, and the coil primary, which is negligibly low. In the audio circuit, there is the additional resistance of the transformer primary which runs from 1500 to 2000 ohms. The detector plate circuit resistance is still higher on account of the additional resistance in the voltage divider. In case a resistance coupled audio stage follows the detector, the plate circuit also contains the coupling resistor, which generally is 250,000 ohms. These differences in resistance can also be used to locate and identify the various circuits. R.F. grid circuits not employing grid suppressors have practically no resistance to ground, while audio frequency grid circuits involve the transformer secondaries which vary from 3000 to 4000 ohms. If grid suppressors are used, these range from 400 to 1000 ohms.

The next step is to locate the defective part. Fasten one prod or terminal of the continuity tester to one end of the faulty circuit and then touch successive parts with the other prod. By progressing step by step, it will not be difficult to hit upon the defective part. For example, if an R.F. plate circuit is found open, attach one test prod successive parts up to the filament terminal of the rectifier tube.

In testing from the socket filament terminals to ground, the resistance encountered will depend upon the circuit and tubes used. With tubes of the 226 type, the grid biasing resistor will be in series with a center tapped resistor across the filament circuit. A resistance of from 400 to 2000 ohms will be met here. With 227 tubes no such biasing resistor will be found, only occasionally a low center tapped resistor with the tap connected directly to ground. In testing from ground to the cathode socket terminal of 227 type tubes used as amplifiers, the biasing resistance of from 400 to 2000 ohms will be encountered. In testing to the cathode of the grid leak detector, the resistance will be zero; but with a power detector a resistance of from 10,000 to 50,000 ohms will be met.

SERVICING B-POWER UNITS

In testing B-power units only a high resistance voltmeter should be used (from 800 to 1000 ohms per volt), otherwise the current drawn by the meter will cause large internal voltage drops and the readings will have no meaning. The following procedure is applicable to B-power units in A.C. electric sets and to B-eliminators as used with battery operated sets.

When a B-power unit fails due to poor design or scanty use of materials, it is best to return it to the manufacturer for correction and repair. Also, if a defective unit is met which is imbedded and sealed in wax, it may best be to return it to the manufacturer.

B-power units are subject to three faults; low voltage or current output, no voltage at one or all of the taps, and excessive hum in the output. Low voltage output may be due to low line voltage, defective transformer, defective rectifier, excessive load, or excessive resistance in filter system. Voltage failure at one or all of the taps may be due to no input voltage, defective transformer, defective rectifier, open filter circuit, punctured filter or bypass condensers, or burnt out or shorted resistors. Excessive hum in the output may be due to a defective rectifier, a faulty choke or condenser, faulty or missing bypass condenser, or low line voltage.

To locate the cause of low output first measure the line voltage with an A.C. plug in meter. If this is O.K., check the rectifier tube or replace it with a known good tube and note the results. If the tube fails to light or operate, check the continuity of the transformer primary; and if the transformer is defective, replace it. Similarily check the different secondary windings. To measure the load on the power unit, connect a 0-15 milliammeter either into the positive outgoing or negative return line. Finally, if all the transformer voltages appear to be correct and suspicion falls on the filter system, check the continuity of this circuit. First check the entire circuit, and if it is found to be open, check the individual sections. If one of the chokes is found defective, it may be necessary to return the unit to the manufacturer.

Another means of testing for a defective transformer is to remove the rectifier tube and connect a 25-watt 110-volt lamp in series with the transformer primary winding. If the secondary winding is all right, the lamp will glow very dull, if at all. But if the lamp glows up bright, either the winding is defective or a buffer condenser is broken down. If buffer condensers are used, they can be removed and tested separately. Then with the lamp still in the primary circuit, insert the rectifying tube into its socket, and if the connections are O.K. and the tube is operating properly, the lamp will increase in brilliancy.

An open-circuited or burned-out resistor will result in no voltage at the tap it controls. Also, the voltages across the other taps will be greatly unbalanced. The simple method of locating a defective resistor is by means of a high resistance volt meter connected between the negative and each positive tap in turn. If it is found that the tap voltages are all correct and the receiver still does not operate well, the trouble may be due to a defective or punctured bypass or filter condenser.

To test the condensers for a breakdown, a test set consisting of a set of headphones in series with a C. battery is connected across the two terminals of each condenser. If a condenser is in good condition, a distinct click will be heard the first time the test points are applied due to the charging current flowing into the condenser, but at every trial after that only a very faint click will be heard. However, if the condenser is broken down, a loud click will he heard every time the test points are applied.

SERVICING THE DYNAMIC SPEAKER

A dynamic speaker consists essentially of a powerful electro-magnet, a voice coil which carries the signal currents, and the paper or composition cone. Most dynamic speakers are of the D.C. type and have a field winding designed to operate with a current of 35 to 40 mills at approximately 100 volts. The resistance of the windings ranges from 2200 to 2500 ohms in different makes of speakers. On account of the low impedance of the voice coil (usually only a few turns of wire are used), a special speaker input transformer is needed. In a push-pull audio amplifier the output transformer is generally provided with a low impedance secondary which is connected directly to the voice coil, no special speaker input transformer then being required. In some receivers this output transformer forms an integral part of the set itself, while in others it is built into the speaker. In the latter type, there would thus be five wires leading to the speaker, two for the field winding, two from the plates of the tubes to the transformer primary, and one from the center tap of this primary to the positive B-supply. In some this plate supply wire is connected directly to the positive side of the field supply within the speaker and there are thus only four wires leading to the speaker.

The following are the common troubles that are encountered.

RATTLING OR BUZZING. These may be caused by:

A. Overloaded or defective power tubes. The volume control should never be turned higher than is needed. Tubes operated beyond rated output cause distortion which manifests itself as rattling and blasting sounds.

B. Bits of dust, dirt or magnetic particles in the air gap. These can be removed with a blast of air directed into the gap while the field current is turned off, or by running a small strip of slightly moistened paper around the gap.

C. Loose clamping of flexible edge of cone. See that the screws holding the clamping ring are tight and take up any slack in the flexible edge of the cone.

D. Damaged or loose cone. Slight damages to the cone can often be repaired with Ambroid cement. This cement can also be used should the cone have become loosened from the mounting ring. For such a repair the cone and coil will have to be removed from the speaker.

E. Loose screws, nuts, etc. All screws, nuts and bolts on the speaker should be kept well tightened.

F. Sympathetic vibrations. Rattles can often be traced to nearby objects that are set into vibration by the sound waves emitted by the speaker.

G. Voice coil off center. Examine the movable coil, and if it is off center, loosen the necessary screws and recenter it.

LOW VOLUME OR DEAD SPEAKER. These may be due to:

A. Trouble in receiver. Check receiver and make sure it is working properly by substituting another speaker. Also check the suspected speaker by operating it on another set.

B. Low plate voltage caused by a defective power transformer, a defective rectifier or some other fault in the B-supply.

C. Defective input cord on transformer. Test cord leading to voice coil for a broken wire. Also check windings of speaker input transformer, as a defective transformer will deliver no energy to the speaker. Also test cords leading to speaker field and B-supply.

D. Defective voice coil. Although it seldom happens, it might be that the voice coil has become broken in some way or the fine lead wires may have become disconnected.

VACUUM TUBE DATA

Tubes for Use as Detectors and R. F. and A. F. Amplifiers

Type	Use	Fil. Supply	Fil. Volts	Fil. Amps.	Plate Volts	Grid Bias	Plate Mills	Amp. Factor	Mutual Conductance	Max. Output
120	Power Amplifier	4½-Volt Dry Cell. 4-Volt Storage Battery	3.3	.132	135	22.5	6.5	3.3	525	10
112	Power Amplifier	6-Volt St. Batt. 5-Volt Trans.	5.0	.25	135	9	7.0	8.0	1600	120
					157½	10½	9.5	8.0	1700	195
171A	Power Amplifier	6-Volt St. Batt. 5-Volt Trans.	5.0	.25	90	16.5	10	3.0	1200	130
					135	27.0	16	3.0	1300	330
					180	40.5	20	3.0	1500	700
245	Power Amplifier	2½-Volt Trans.	2.5	1.5	180	34.5	26	3.5	1800	750
					250	51.5	32	3.5	1850	1600
210	Power Amplifier	7½-Volt Trans.	7.5	1.25	250	45	28	8	1330	340
					300	54	35	8	1450	600
					350	63	45	8	1550	925
					400	70	55	8	1600	1325
					425	84	55	8	1600	1540
250	Power Amplifier	7½-Volt Trans.	7.5	1.25	250	45	28	3.8	1800	900
					300	54	35	3.8	1900	1500
					350	63	45	3.8	2000	2350
					400	70	55	3.8	2100	3250
					450	84	55	3.8	2100	4650

280	Full Wave Rectifier	Filament Volts	5	Max. D. C. Output Current, Both Plates	125 M. A. 260 Volts		
		Filament Current	2				
		Max. A. C. Plate Volts	300	Max. D. C. Output	Recom.		Max.
281	Half Wave Rectifier	Max. A. C. Plate Volts	750	D. C. Output Current	65 M. A.		110 M. A.
		Filament Volts	7.5	D. C. Output Voltage	650.		650.
		Filament Current	1.25				

VACUUM TUBE DATA

Tubes For Last Audio Stage and Special Purpose Tubes

Type	Use	Fil. Volts	Fil. Amps.	Det. Plate Volts	Det. Plate Mills	Amps. Plate Volts	Grid Bias	Amp. Plate	Mutual Conductance	Amp. Factor
112	Det. or Amplifier	1.1	.25	22.5 to 45	1.5	90	4.5	2.5	425	6.6
						135	10.45	3.5	440	6.6
199	Detector or Amplifier	3.3	.063	45	1	90	4.5	2.5	425	6.6
200A	Detector	5.0	.25	45	1.5	—	—	—	666	2.0
201A	Det. or Amplifier	5.0	.25	45	1.5	90	4.5	2.5	725	8
							9.	3.	800	8
112A	Det. or Amplifier	5.0	.25	45	1.5	90	4.5	5.5	1500	8
						135	9.	7.	1600	8
222	R. F. Amplifier	3.3	.132	—	—	135	1.5	1.5	350	300
222	A. F. Amplifier	3.3	.132	—	—	180	1.5	.3	400	60
226	R.F. & A.F. Amplifier	1.5	1.05	—	—	90	6	5.5	875	8.2
						135	9	6.	1100	8.2
						180	13.5	7.5	1170	8.2
227	Detector Only	2.5	1.75	45	2	—	—	—	800	8.
				90	7	—	—	—	800	8.
227	Amplifier Only	2.5	1.75	—	—	135	9	5	1000	9
						180	13.5	6	1000	9
224	R. F. Amplifier	2.5	1.75	—	—	180 Shield Grid	1.5 75	4	1050	420
240	Det. or Amplifier	5.0	.25	135	.3	135	1.5	.2	200	30
				180	.4	180	3.0	.2	200	30

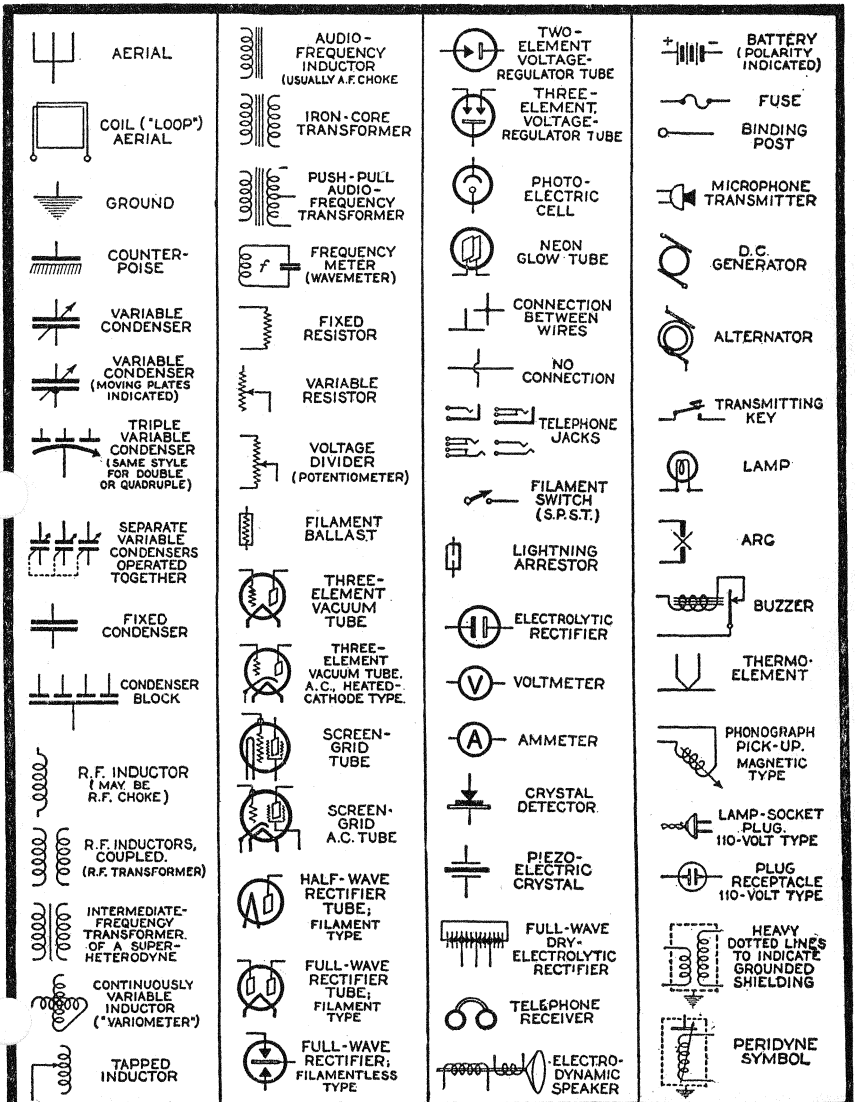
SOME IMPORTANT SERVICE POINTERS

1. Always know what you are doing and have a reason for everything you do, do not fumble aimlessly.
2. Always make a complete test of a set and do not jump at hasty conclusions, something may have deceived you.
3. When taking a voltage or current test, be sure you have the right meter with the proper range. Meters are easily ruined.
4. Do not attempt to operate an A.C. electric set on a direct current circuit. Something will be damaged.
5. Do not attempt to operate a 60-cycle A.C. electric set on a 25-cycle circuit. The transformer will overheat and burn out.
6. A 25-cycle set can safely be operated on a 60-cycle system without fear of damaging anything.
7. When testing tube voltages always have the volume control full on and "local-distance" switch in "distance" position.
8. In the case of heater type A.C. tubes, grid and plate voltages are always given with respect to the cathode, unless otherwise stated.
9. Do not be alarmed at small variations from the voltages specified, as these may be due to different line values or to slight variations in the transformers or resistor values.
10. In case an R.F. transformer must be replaced, it is best to replace the entire set to obtain a perfectly matched group.
11. A small hole in a cone speaker can be repaired by cementing a small piece of cone-fabric over the damaged part. Use Ambroid or Duco Household Cement.
12. A completed repair job should always resemble a new receiver in appearance and performance.
13. Don't take short cuts. Remember there is a reason for everything being done in a prescribed manner.
14. There is no real substitute for a good overhead aerial, although conditions may at times necessitate the use of some form of indoor aerial.
15. The fact that a tube delivers a high plate current is not a sign that it is a good amplifier. It should show a substantial current change when the grid potential is varied.
16. When testing B-power units always use a high resistance voltmeter, as otherwise the current drawn by the meter itself will cause excessive internal voltage drop.
17. Broad tuning in a receiver can often be corrected by shortening the aerial, by connecting a small fixed condenser in series with the aerial, or by establishing a better ground connection.
18. If a power tube develops a purplish haze, it is an indication that the plate voltage is excessive or that gas has been liberated within the bulb.
20. B-batteries should always be tested when the set is turned on, as a no-load test gives no indication of the actual condition of the battery.
21. Interference from small motors can generally be eliminated by connecting a 1-mfd condenser from each line to the ground at the motor terminals.
22. A fluctuating or unsteady plate current is often due to an open grid circuit in the audio stages.
23. An indication that a Raytheon rectifier tube is exhausted is a generally low or widely fluctuating plate current.
24. The sudden appearance of hum and fading reception accompanied by low voltage is generally due to a defective or gassy type 280 rectifier tube.
25. A distinctive hum in sets using type 226 tubes may often be due to excessive line voltage.

AVERAGE CHARACTERISTICS OF ARCTURUS RADIO TUBES

Type	Filament Volts	Filament Current	Plate Voltage	Control Grid Bias	Screen Grid Bias	Plate Current (M. A.)	Plate Resistance (ohms)	AMP. Factor	Mutual Conductance
22	15.0	0.35	135	— 1.0	30.0	1.0	700,000	400	570
26	15.0	0.35	90	— 1.5		7.5	9,000	10.5	1165
28	15.0	0.35	90	— 1.5		7.5	9,000	10.5	1165
30	15.0	0.35	180	—27.0		22.0	3,500	3.8	1085
32	15.0	0.35	135	— 3.0		1.5	32,000	30.0	940
40	15.0	0.40	180	—40.5		21.0	2,000	3.0	1500
46	15.0								
48	15.0	0.35	90	— 4.5		4.5	9,200	10.9	1185
126	1.5	1.05	180	—13.5		7.4	7,000	8.2	1170
127	2.5	1.75	45			Detector			
127	2.5	1.75	180	—13.5		5.0	9,000	9.0	1000
071-A	5.0	0.25	180	—40.5		20.0	2,000	3.0	1500
180	5.0	2.00	400			110			
124	2.5	1.75	180	— 3.0	90.0	4.0	400,000	400	1000
145	2.5	1.50	250	—50.0		32.0	1,900	3.5	1850
012-A	5.0	.25	135	9		7.0	5,000	8	1600
A.C. or D.C.									
			157½	10½		9.5	4,700	8	1700
			180	13½		9.5	4,700	8	1700
099	3.3	D.C. .063	90	4½		2.5	15,500	6.6	425
101-A	5.0	D.C. .25	135	9		3	10,000	8	800
122	3.30	D.C. .132	135	1½	45	1.5	850,000	300	353
150	7.5	A.C. 1.25	250	45		28	2,100	3.8	1810
			300	54		35	2,000	3.8	1900
			350	63		45	1,900	3.8	2000
			400	70		55	1,800	3.8	2110
			450	84		55	1,800	3.8	2110

STANDARD RADIO SYMBOLS



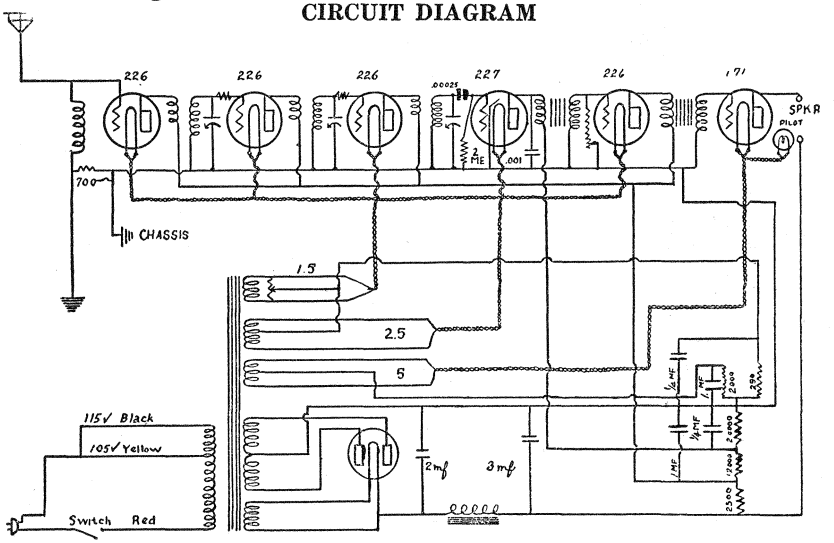
THE ACME A.C.-7

The Acme A.C. 7 is a 7-tube A.C. electric receiver made by the Acme Electric & Mfg. Co. at Cleveland, Ohio. The receiver employs type 226 tubes in the three R.F. and first audio stages, a 227 tube in the detector, and a type 171A tube in the output stage. The tuning system consists of an antenna and three R.F. transformers tuned with a 3-gang condenser. Resistors of 800 ohms are used in the grid circuits of the 2nd and 3rd R.F. tubes. In the detector circuit a .00025-mfd. grid condenser and a 2-megohm leak are used, and a .001-mfd. condenser bypasses the plate to the ground. Standard audio transformers are used in the first and second stages. Volume is controlled by means of a 500,000-ohm resistor across the secondary of the first audio transformer. A 5-volt pilot light is connected across the filament circuit of the output tube.

The power supply system has an input transformer with a tapped primary and five secondaries, a 1½-volt winding for the 226 tubes, a 2½-volt winding for the 227-tube, a 5-volt winding for the 171A tube, another 5-volt winding for the filament of the rectifier tube, and a high voltage plate supply winding. The filter consists of a choke coil and a 2-section filter condenser of 2 and 3 mfds. respectively. The voltage divider consists of a 3-section resistor of 2,500, 12,000, and 20,000-ohms. The grid of the output tube is biased through a 2000-ohm resistor connected between the center tap of the filament winding and the negative B line. The grids of the three R.F. and first audio tubes are similarly biased through a 250-ohm resistor. As shown in the circuit diagram, suitable bypass condensers are used across these resistors.

When a powerful local station is tuned in and distortion is expeienced due to the detector tube overloading, even though the volume control is turned down, this condition can be remedied by connecting a 7500-ohm variable resistor across the antenna choke coil. This resistor can then be used to control the amount of energy supplied to the R.F. amplifier and in this manner avoid passing an excessive load through the detector.

CIRCUIT DIAGRAM



THE ACME—MODEL 88

The Acme model 88 is an 8-tube A.C. receiver employing 3 stages of tuned R.F. amplification with type 224 tubes, a detector and 1st audio stage each with a type 227 tube, and an output stage with two type 245 tubes in push-pull. A type 280 fullwave rectifier is used. The tuning system consists of an antenna coupler and three R.F. transformers all tuned with a 4-gang condenser. Volume is controlled with a 5000-ohm variable resistor that regulates the screen grid voltage of the three R.F. tubes. A .0001-mfd. condenser bypasses the plate of the first R.F. tube to ground. The grids of the three R.F. tubes are biased with a 100-ohm resistor (brown) connected into the cathode circuit. This resistor is bypassed by a .1-mfd. condenser.

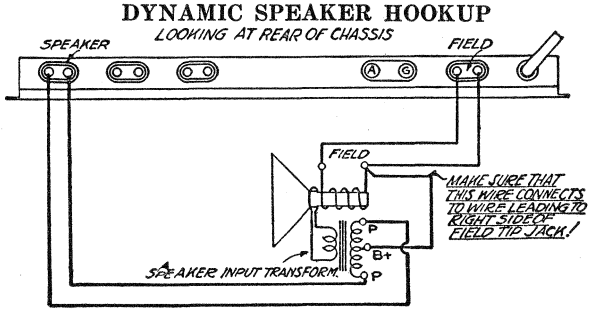
In the detector circuit a .00025-mfd. grid condenser and 1-megohm leak are used. The high frequency currents are kept out of the audio stages by means of an R.F. choke and a .006-mfd. bypass condenser from plate to ground. The detector is coupled to the first audio tube through a standard audio transformer. The grid of this tube is biased through a 2000-ohm cathode resistor (yellow) which in turn is bypassed by a .1-mfd. condenser.

The power supply system has an input transformer with two 2½-volt filament secondaries, a 5-volt secondary for the filament of the rectifier tube, and a high-voltage plate supply winding. In the filter system a 30-henry choke and a 3-section (8 mfds. each) Mershon filter condenser are used. The speaker field which has a resistance of from 2000 to 2250 ohms serves as a second filter choke. The filter output is supplied directly to the plate circuit of the power tubes, while the drop in the field winding reduces the pressure to the value required for the three R.F. and first audio tubes. An additional 4000-ohm resistor (large brown) further reduces the pressure for the plate circuit of the detector tube. The grids of the two power tubes are biased through a 1000-ohm resistor connected between the grounded chassis and the center tap on a 40-ohm filament resistor. Another 20-ohm resistor with the center tap grounded is connected across the other 2½- volt filament winding.

TUBE VOLTAGES

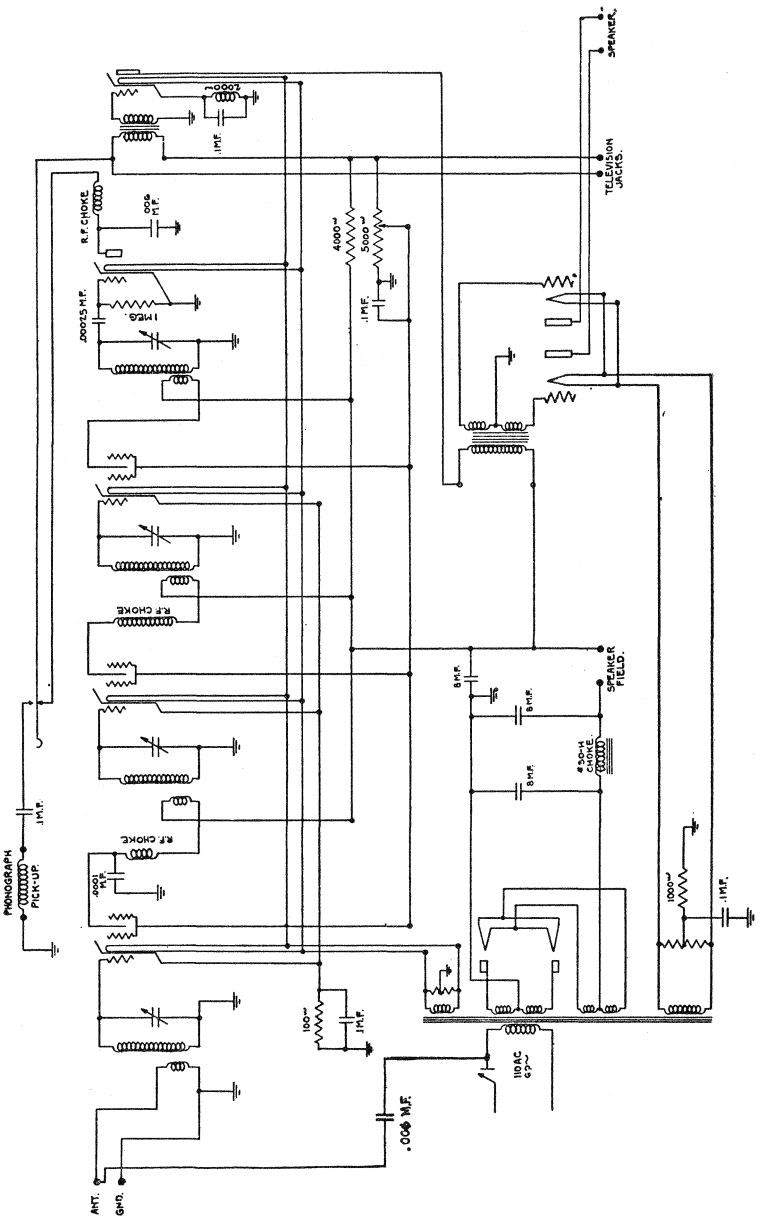
Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's	Screen Volts
R.F. Stages	224	2.1	180	1.2	3.6	90
Detector	227	2.1	75	—	7.0	—
1st Audio	227	2.1	180	8	5.0	—
2nd Audio	245	2.25	250	50	32.	—

DYNAMIC SPEAKER HOOKUP



DYNAMIC SPEAKER HOOKUP

ACME MODEL 88



BALKEIT MODELS A-3, A-5 AND A-7

The Balkeit A series receivers are 8-tube A.C. operated sets employing type 227 tubes in the R.F. stages, detector and first audio stage, two type 112-A tubes in push-pull in the output stage, and a type 280 full wave rectifier in the power supply system.

The tuning system is of the balanced neutrodyne type employing an antenna coupler and three tuned R.F. transformers. Three balancing or neutralizing condensers are provided, and the circuit is balanced in the customary manner. Volume is controlled by means of a variable resistor in series with the plate circuits of the second and third R.F. tubes. A phonograph pick-up jack is also provided. This is a double-circuit jack connected across the primary of the first audio transformer, and when the phonograph plug is inserted the R.F. tubes and detector are automatically disconnected from the audio system.

A single 2½-volt filament circuit is used for supplying current to the five 227 tubes. Connected across this filament circuit is an A.C. hum control consisting of a 20-ohm center-tapped resistor with the tap connected to ground. The three R.F. tubes and first audio tubes each have a 1600-ohm cathode biasing resistor which places a 5-volt negative potential on the grid. These resistors are shunted by .001 bypass condensers. Each R.F. plate lead contains a filter consisting of a resistance to choke back the R.F. oscillations and a bypass condenser to return them to the cathode. The detector cathode is connected directly to ground. A .002 condenser is also connected from the detector plate to ground. In the output stage a 50-ohm center-tapped resistor is connected across the filament circuit, and between the center-tap and the ground is a 500-ohm grid biasing resistor. A 5-volt dial light is also connected across this filament circuit.

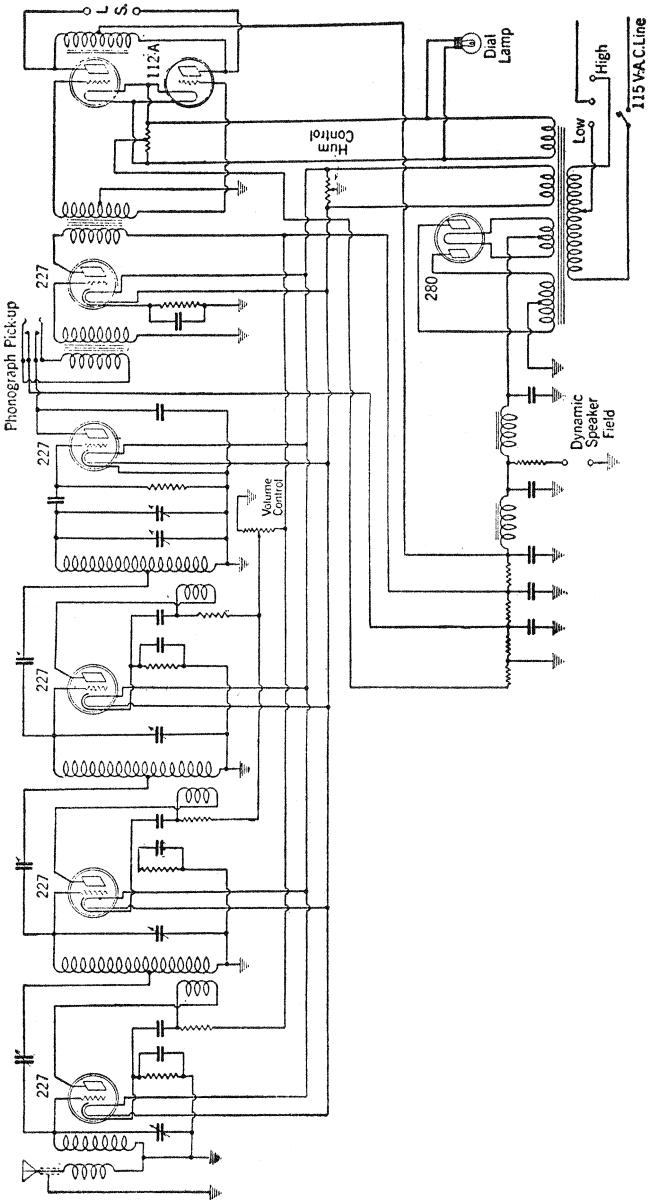
In the power unit an input transformer is used, a 3-section condenser block, two filter chokes, and voltage dividing resistor. The input transformer primary is designed for a 115-volt line pressure, but also has a 110-volt tap. There are three filament secondaries, and a high voltage plate supply secondary with a center tap for the negative B return. In the voltage divider two 1-mfd. bypass condensers are used across the two sections of the resistor. The dynamic speaker field is connected in parallel with the B-supply load on the set, a tap being taken off between the two filter chokes. The resistor in series with the speaker reduces the field current to the required value of 40 mill's.

In the following table are given the plate and filament voltages at the various sockets. The high voltage tap is used with a line pressure of 115 volts. All tubes are in their respective sockets and the volume control is full on.

Position	Type Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mills
1st R.F.	227	2.1	84	5	3.1
2nd R.F.	227	2.1	84	5	3.1
3rd R.F.	227	2.1	84	5	3.1
Detector	227	2.1	30	0	2.2
1st Audio	227	2.1	84	5	3.1
2nd Audio	112A	4.5	132	9.5	9.0
2nd Audio	112A	4.5	132	9.5	9.0
Rectifier	280	4.5	—	—	32.

In general, the circuit is quite simple and not readily subject to any serious ills or mishaps. In case the set lacks pep, it may be that the high tap is being used on the input transformer and the line voltage is low. Corrosion or accumulation of dirt at the jack contacts may also interrupt the operation of the receiver. Breakdown of any of the bypass condensers will also cause trouble.

BALKEIT MODELS A-3-5-7



BALKEIT MODEL C A.C. RECEIVER

The Balkeit Model C receiver is an 8-tube A.C. neutrodyne employing four stages of tuned R.F. amplification with type 227 tubes, a detector and resistance coupled first audio stage each employing a type 227 tube, and a second audio or output stage with two type 245 tubes in push-pull.

The antenna coupler and R.F. transformers each consist of three separate windings, a tuned secondary and two primary windings one of which is untuned and the other tuned with a .00025 fixed condenser C-6. This design results in a more uniform sensitivity over the entire wave length range. A 5-section tuning condenser is employed, and adjustable neutralizing condensers are provided for each R.F. stage. Plate filters consisting of fixed resistances and two .25-mfd. condensers (C-4) are used to reduce coupling between the several stages through the common plate current supply. Volume is controlled with a 15,000-ohm potentiometer, R-6 connected in the cathode circuit of the four R.F. tubes and also between the antenna and ground. Thus the input signal voltage and the grid bias of the R.F. tubes are varied simultaneously. A .25-mfd. condenser C-3 is used to bypass the 2000-ohm R.F. grid bias resistor R-5.

In the detector circuit grid bias detection is employed by biasing the cathode with a 25,000-ohm resistor R-1. This is bypassed by the .1-mfd. condenser C-7. A .002 condenser is also connected from the detector plate to the cathode to provide a low-resistance return path for the radio frequency components of the plate current. The detector feeds directly into a resistance coupled audio stage employing a .1-megohm coupling resistance R-3, a .5-megohm grid resistance R-11, and a .1-mfd. coupling condenser. The cathode is biased by means of resistor R-2 of 1750 ohms. This resistor is bypassed by the 1-mfd. condenser C-7.

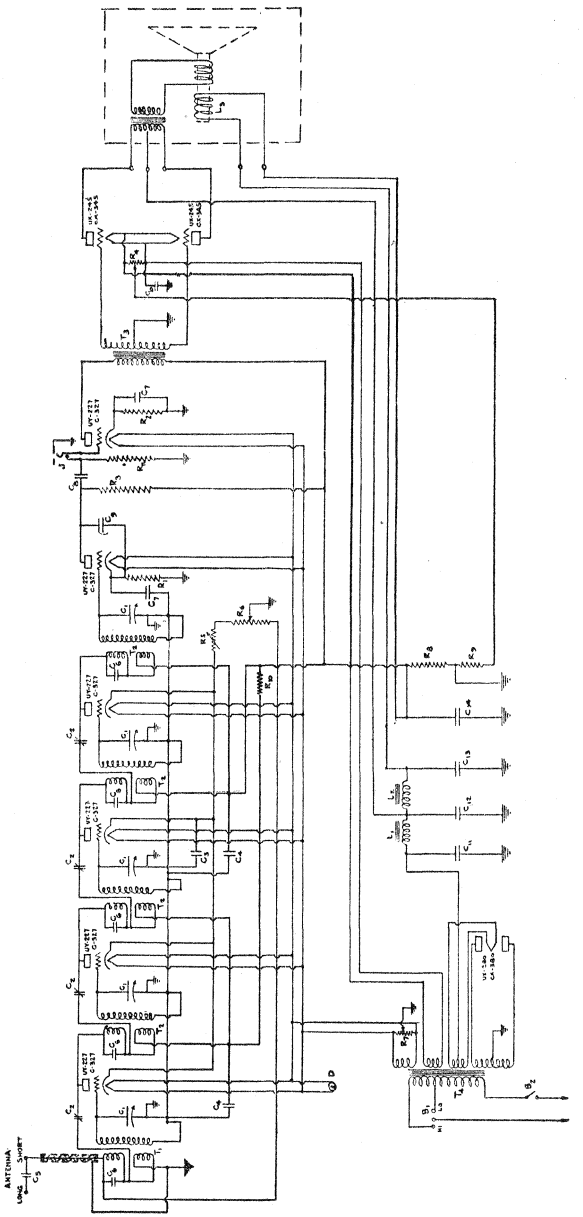
The second audio stage has two type 245 tubes in push-pull. Across the filament circuit of these tubes is a 20-ohm center-tapped resistor R-4, the tap being connected through a 770-ohm biasing resistor R-9 to ground. This resistor is bypassed by the .25-mfd. condenser C-10. The output transformer is built into and forms an integral part of the speaker.

The power supply consists of an input transformer, full-wave rectifying tube (type 280), a suitable filter and bleeder resistor. The transformer has a tapped primary and four secondary windings. One is a 2½-volt winding and supplies filament current to the first six tubes. Connected across it is also a 20-ohm resistor with a movable center tap to serve as a hum control. Another 2½-volt winding supplies filament current to the two power tubes. The third is a 5-volt winding and supplies filament current to the rectifying tube, while the fourth is a center-tapped high voltage plate supply winding. A 3-stage filter circuit is employed utilizing the field coil of the dynamic speaker as the third choke. The filter circuit is tapped to obtain the voltages for the 245 and 227 tubes, so that the two power pack resistors simply provide bleeding current and grid bias for the 245 tubes. R-8 has a value of 3600 ohms and R-9 770-ohms. The filter condenser has three 2-mfd. sections (C-11, C-12 and C-13) and one 1-mfd. section (C-14).

TUBE VOLTAGES

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills.
1st, 2nd, 3rd and 4th R.F.	227	2.35	117.	10.	3.8
Detector	227	2.35	62.	8.5	0.3
1st Audio	227	2.35	117.	2.0	4.6
2nd Audio	245	2.30	225	41.	24.0
Rectifier	280	4.75	—	—	94.0

BALKEIT MODEL C



BALKEIT MODEL F A.C. RECEIVER

The Balkeit Model F is an 8-tube A.C. neutrodyne employing three stages of tuned R.F. amplification with tubes of the 227 type, a tuned screen grid detector with a type 224 tube, a stage of resistance coupled audio amplification with a 227 tube, and an output stage with two 245 tubes in parallel.

The tuning system consists of an antenna coupler and three tuned R.F. transformers. The antenna coupler has a high inductance primary wound on a spool mounted inside of the secondary, the latter being space wound. The R.F. transformers consist of two windings, a tapped secondary and a closely coupled primary wound over the secondary. A 4-gang tuning condenser is used, with a trimmer C-6 connected across the detector section. Adjustable neutralizing condensers are also provided in each R.F. stage. Plate and grid bypass condensers (C-3 and C-4) of .25 mfd. each are used to reduce coupling between R.F. stages. The antenna condenser C-5 has a capacity of .00025 mfd.

Volume is controlled with a 15,000-ohm potentiometer connected in the cathode circuit of the three R.F. tubes and also between the antenna and ground. The input signal voltage as well as the grid bias on the R.F. tubes are thus varied simultaneously. A 620-ohm fixed resistor R-2 in series with the volume control prevents the grid bias from being reduced below the required minimum value.

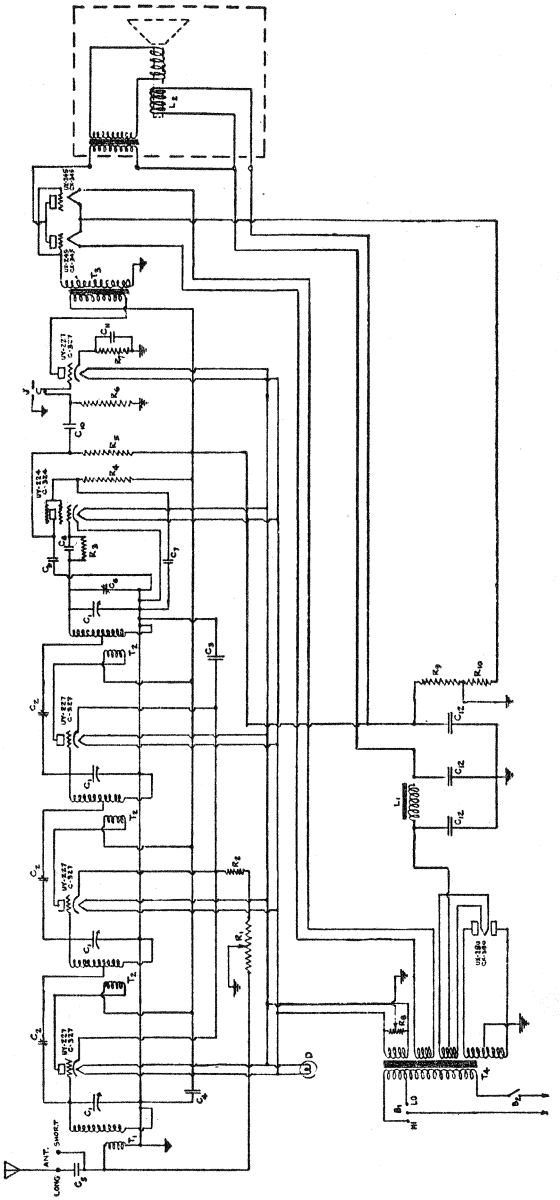
A type 224 tube is used as a detector, grid detection being employed with the aid of a .5-megohm control grid resistance R-3 and the .0001-mfd. condenser C-8. Another .5 megohm resistor R-4 is used in the screen grid lead. It is bypassed by a .25-mfd. condenser C-7. The detector feeds into a resistance coupled first audio stage employing a .1-megohm coupling resistor R-5, a 0.1-mfd. coupling condenser C-10, and a .5-megohm grid resistor R-6. A .0005-mfd. bypass condenser C-9 is connected from the detector plate to ground. Grid bias for the first audio stage is obtained through the 1750-ohm cathode resistor R-7 which is bypassed by the .5-mfd. condenser C-11. A phonograph pick-up jack is provided and arranged so that inserting the plug disconnects the detector tube and connects the pick-up to the grid of the first audio tube. The second audio stage has two 245 tubes in parallel with their filaments connected in series. The mid-point is grounded through a 650-ohm biasing resistor R-10. The output transformer is built into and forms an integral part of the dynamic speaker.

The power supply consists of an input transformer, a type 280 full wave rectifier, and a suitable filter. The transformer primary is tapped to accommodate different line voltages. There are four secondary windings, three filament and one high voltage plate winding with the negative return connected to the center tap. The 2½-volt filament winding supplying the first five tubes has a 20-ohm hum control resistor connected across it, R-8. A two-stage filter system is used, utilizing the field coil of the dynamic speaker as the second choke. The filter circuit is tapped to obtain the necessary plate voltages for the 227 and 245 tubes, so that only the lossing or bleeder current resistor (R-9, 4500 ohms) is required. An 8 mfd. per section Mershon filter condenser is employed.

TUBE VOLTAGES

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills
1st, 2nd and 3rd R.F.	227	2.3	115	7.0	3.8
Detector	224	2.3	50	0.2	0.7
1st Audio	227	2.3	100	8.5	6.2
2nd Audio	245	2.4	175	31	28
Rectifier	280	4.75	—	—	90

BALKEIT MODEL F



PHILCO MODELS 20 AND 20A

The Philco Models 20 and 20A are 7-tube chasses mounted in a mantel-clock type cabinet. Model 20A differs from model 20 in a few details is indicated below. The tuning system in each model consists of an antenna coupler and two R.F. transformers all tuned with a 3-gang condenser. Volume is controlled through a dual resistor, one section of which regulates the antenna input while the other regulates the cathode bias of the two R.F. tubes. The detector is of the grid bias type and has its cathode biased through a 50,000-ohm resistor No. 12 which is bypassed by a .5 mfd. condenser. In the resistance coupler between the detector and 1st audio a 500,000-ohm plate resistor and a similar filter resistor are used with a .25 mfd. bypass condenser. A .01 coupling condenser is used and a 500,000-ohm grid leak. A standard input transformer feeds into a second audio stage with two type 171A tubes in push-pull. The output transformer is built into and forms an integral part of the speaker.

In the power supply the input transformer provides a 2½-volt filament circuit for the radio frequency, detector, and first audio tubes, a 5-volt filament circuit for the two output power tubes, a 5-volt circuit for the filament of the rectifier tube, and a high voltage plate supply winding. The filter system employs a tuned choke and two filter condensers. On leaving the filter circuit the high voltage line divides, one branch going to the plate circuits of the R.F. tubes while the other leads through the speaker field with a tap taken off for the plate supply of the two output tubes. The circuit then further divides, one branch leading to the plate circuit of the 1st audio and detector tubes, and the other to the voltage divider at J where a tap is taken off at G for the screen grids of the two R.F. tubes, and another tap at F for the screen grid of the detector tube and for the cathodes of the two R.F. tubes. The cathode of the first audio tube is grounded to the chassis, but the grid is brought directly to the negative side of the high-voltage system. Since the chassis is connected to the voltage divider resistor at point 3, the voltage drop across points 2-3 (187-ohms) becomes the grid bias for the first audio tube. The voltage drop across points 1-2 (1400-ohms) forms the grid bias for the two output power tubes.

Model 20-A is wired differently than the Model 20. The plate supply lead for the two 224 R.F. tubes is taken from the low side of the speaker field coil. The lead D to the 224 tubes should be changed to J for the Model 20-A only. This will change the plate voltage from 250 to 115-125 volts. The plate current readings will also be lower than those given in the table below.

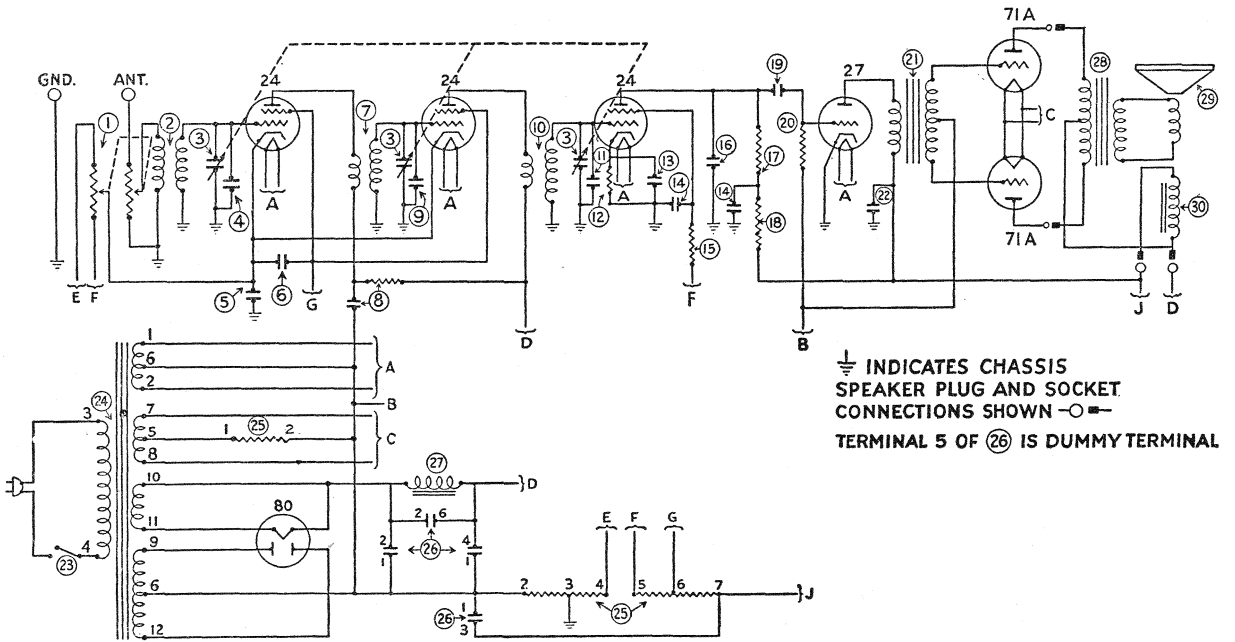
Resistor Data		Condenser Data	
No. 18	100,000 ohms	No. 5, 6, 22	.05 mfd.
No. 17-20	500,000 ohms	No. 8	.05 mfd. & 250-ohms
No. 15	250,000 ohms	No. 13	.5 mfd.
No. 25 (3-4)	75 ohms	No. 14	.25 mfd.
No. 25 (5-6)	2470 ohms	No. 16	.00025 mfd.
No. 25 (6-7)	975 ohms	No. 19	.01 mfd.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's	Screen Volts	Cathode
1st R.F.	224	2.3	250	3.0	4.5	90	12
2nd R.F.	224	2.3	250	3.0	4.5	90	11
Detector	224	2.3	35	1.0	—	2	8
1st Audio	227	2.3	120	1.0	3.0	—	8
2nd Audio	171A	5.0	215	50.0	18.0	—	—
2nd Audio	171A	5.0	215	50.0	18.0	—	—

PHILCO MODELS 20 AND 20A

Models 20 and 20-A



PHILCO MODEL 41

The Philco Model 41 is a 6-tube chassis designed for operation from a 110-120 volt D.C. circuit. A dual-tuned preselector circuit is used, followed by two stages of tuned radio frequency amplification employing type 224 tubes. Volume is controlled by means of a double resistor, one section of which regulates the antenna input and the other controls the cathode voltage of the two R.F. tubes. A section of the primaries of the two R.F. transformers is shunted by a small fixed condenser so that the R.F. response will be more uniform over the entire frequency range. The detector is of the grid bias type and also employs a 224 tube. It feeds into a resistance-coupled first audio stage using a type 227 tube, and this is followed by a push-pull output stage with two type 171A tubes. A tone control is provided in the form of a group of fixed condensers across the primary of the push-pull input transformer.

In the power supply the positive side of the line leads through the dynamic speaker field and sends off two branches to the plate circuits of the first and second audio stages. The current in the main line here is 1.75 amperes. The circuit at R then leads through a large external resistor of 53 ohms (No. 38). At this point C the detector screen grid voltage and the plate voltages for the detector and R.F. tubes are tapped off. The current continues through another 2-ohm resistor to point B where the filament current (.5 ampere) for the two 171A tubes is tapped off. The balance of the current (1.75—.5 or 1.25 amperes) flows through the 4-ohm resistor No. 37 to point A where it again combines with the 171A filament current and enters the filaments of the three 224 tubes which are connected in series. The circuit then returns to the negative side of the line at G. Where the positive line enters the receiver a tap is taken off which leads through a filter choke No. 35 to these three places: through the 5000-ohm resistor 36 to the R.F. screen grids at S, to the R.F. plate circuits at P, and through the 25,000-ohm resistor No. 34 to the R.F. cathode circuit at V. The values of the various resistors and bypass condensers are given in the following table.

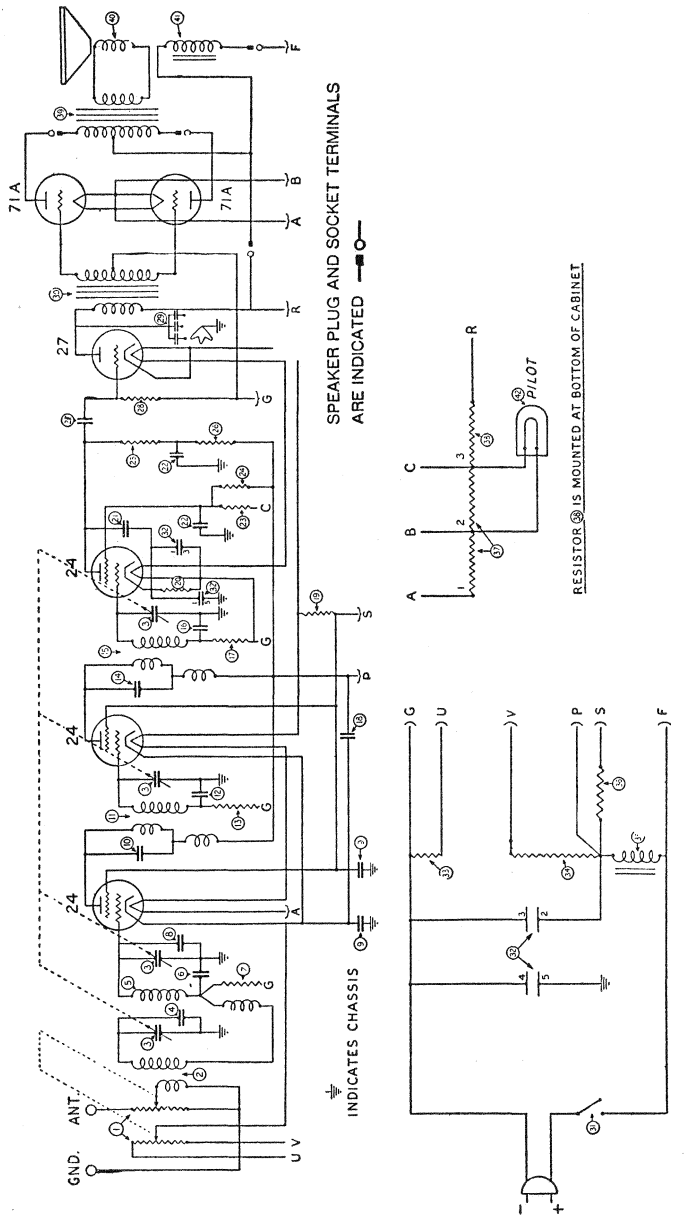
Resistors		Condensers	
No. 17 & 36	5000 ohms	No. 6	.01 mfd.
No. 23	13,000 ohms	No. 9	.25 mfd.
No. 19 & 34	25,000 ohms	No. 12	.05 mfd.
No. 7 & 13	33,000 ohms	No. 16 & 18	.05 mfd.
No. 24	70,000 ohms	No. 21	.0005 mfd.
No. 20 & 26	100,000 ohms	No. 22	.25 mfd.
No. 33	250 ohms	No. 27	.01 mfd.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.	Screen Volts
1st R.F.	224	2.1	100	.4	2.7	75
2nd R.F.	224	2.1	100	.4	2.7	75
Detector	227	2.1	45	1.8	—	75
1st A.F.	227	2.4	87	.2	2.7	—
2nd A.F.	171A	5.	85	13.	15.	—
2nd A.F.	171A	5.	85	13.	15.	—

For adjusting the compensating condensers it is always best to use an oscillator signal. Adjust oscillator and receiver at between 120 and 140 on the tuning scale with the volume control turned full on. With a fiber wrench turn the adjusting nut of the first compensating condenser clear down tight. Then adjust the second compensating condenser very carefully, and after this is done adjust the first in the same manner.

PHILCO MODEL 41



PHILCO — MODELS 77 AND 77A

The Philco Model 77 is a 7-tube receiver employing two stages of tuned R.F. amplification, a grid bias detector, a resistance coupled 1st audio stage, and a push-pull output stage. Screen grid tubes of the 224 type are used in the R.F. stages and the detector, a 227 tube in the 1st audio, and two 245's in the output stage. The tuning system consists of a double tuned input circuit and two R.F. transformers, all tuned with a 4-gang condenser. A section of the R.F. transformer primaries is tuned so that a more uniform gain is had over the entire frequency range. A dual volume control is employed, one section being a variable resistor across the antenna primary and the other a resistor for varying the cathode bias of the two R.F. tubes.

The tone control consists merely of a group of three fixed condensers and a switching arrangement by means of which either one, two or all three of the condensers can be shunted across the primary of the push-pull input transformer. The greater the capacity shunted across the winding the more prominent the lower notes and less prominent the higher notes become.

In the power supply system the input transformer has three filament secondaries and one high voltage plate supply winding. In the filter system a tuned choke is used to eliminate the 60 and 120-cycle hum. The dynamic speaker field forms the second filter choke, but between the two the tap is taken off for the plate supply of the two power tubes. On leaving the speaker field the B line branches through a number of resistors to the plates of the various tubes. The values of these resistors are given in the table below. One branch leads through a special 3-section series resistor from the first tap of which a lead goes to the screen grids of the first two tubes. From the second tap a lead goes to the screen grid of the detector tube, while the end terminal is connected to the volume control resistor in the cathode circuit of the two R.F. tubes. The bleeder current and R.F. plate current then return to ground potential through resistor 29. An analysis of the circuit will reveal that the chassis and ground are above negative B potential by an amount equal to the voltage drop across terminals 1 and 2 of resistor 26, which is also equal to the grid bias of the 1st audio tube. The grids of the power tubes are further biased across terminals 2 and 3 of resistor 26.

CONDENSER DATA

No.	Value	Color
30 (1 & 2)	1400	Long Tubular
(2 & 3)	1500	
(3 & 4)	2000	
26 (1 & 2)	250	Short Tubular
(3 & 4)	800	
12	100000	Silver Gray
18	100000	Silver Gray
15	250000	White
17	500000	Battleship Gray
20	500000	Battleship Gray
29	85	Flatwire Wound

RESISTOR DATA

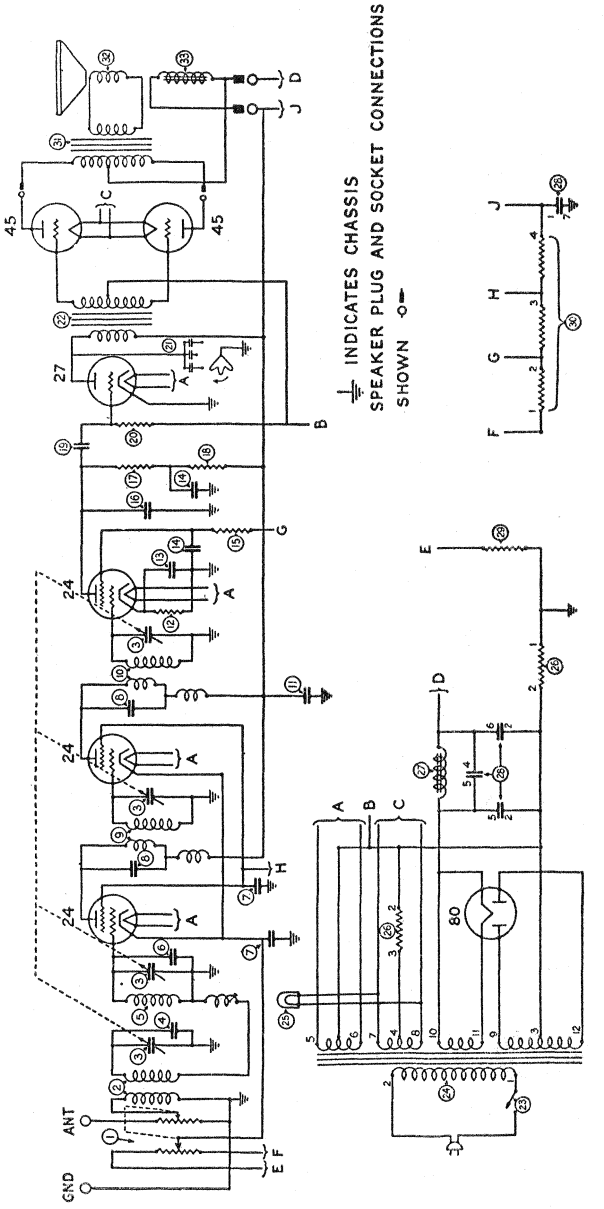
No.	Cap.	D.C. Volts	
7	.25	95	S. Gr. Cond.
	.25	15	Cathode Cond.
11	.05	150	
13	.5	12	
14	.25	95	Plate R
		40	S. Gr.
16	.00025	40	
19	.01	25	

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's.	Cathode Volts	Screen Grid
1st R.F.	224	2.3	145	3	3.5	13	90
2nd R.F.	224	2.3	145	3	3.5	13	90
Detector	224	2.3	36	1.4	0	12	30
1st Audio	227	2.3	140	1	30	10	—
2nd Audio	245	2.2	230	46	50	—	—
Rectifier	280	4.5	—	—	—	—	—

Also see last two paragraphs on the page describing Philco Model 41.

PHILCO MODELS 77 AND 77A



PHILCO — MODELS 96 AND 96A

The Philco models 96 (60 cycles) and 96A (25 cycles) are 9-tube receivers employing a double tuned input circuit and three stages of tuned R.F. amplification with type 224 tubes. The detector circuit uses two 227 tubes. The first has the grid and plate connected and functions as a 2-electrode rectifier or as the detector proper. The second is the detector amplifier. The automatic volume control is associated with the detector and R.F. amplifier, and by means of it the grid bias voltage of the R.F. tubes is automatically adjusted in proportion to the strength of the signal to increase or decrease the R.F. amplification and hence also the volume output of the receiver. See also the description of the Philco Model 95.

The first audio stage uses resistance coupling into a 227 tube with a variable resistor in the grid input circuit that serves as a volume control. The second is a push-pull stage with type 245 tubes. The output of these tubes is supplied to the voice coil of the dynamic speaker through an output transformer built into the speaker. The power supply contains a transformer with the necessary high voltage and filament windings, and a tuned filter system. The speaker field serves as a second filter choke. Analysis of the circuit will also reveal that the chassis and ground are above neg. B potential by an amount equal to the voltage drop in resistor 44.

Compensating should be done with the receiver tuned to about 1300 kilocycles, and preferably an oscillator signal should be used, the oscillator being connected to the Ant. terminal and a good ground to the Gn'd terminal. A weak signal should be used and the volume control turned full on. With a fiber wrench adjust the 4th compensating condenser (nearest the detector) to maximum volume. Then in a similar way adjust the 3rd, 2nd and 1st condenser.

RESISTOR DATA			CONDENSER DATA		
No.	Value	Color	No.	Capacity	Volts
1	5,000	Golden Yellow	5, 11, 13	.05	—
14, 36	13,000	Belgium Blue	9, 16	.05	160
37	25,000	Auto Buff	8, 17	.05	110
6, 33, 35	70,000	Jade Green	18	.00005	—
20, 21, 23	100,000	Silver Gray	22	.5	—
24, 32	250,000	White	26	.00025	—
19, 25, 29	500,000	Battleship Gray	27	.00025	30
45	8,300	Long Tubular	28	.015	30
41	800	Short Tubular	31	.05	66
44	70	Flat Wire Wound	50	.015	—

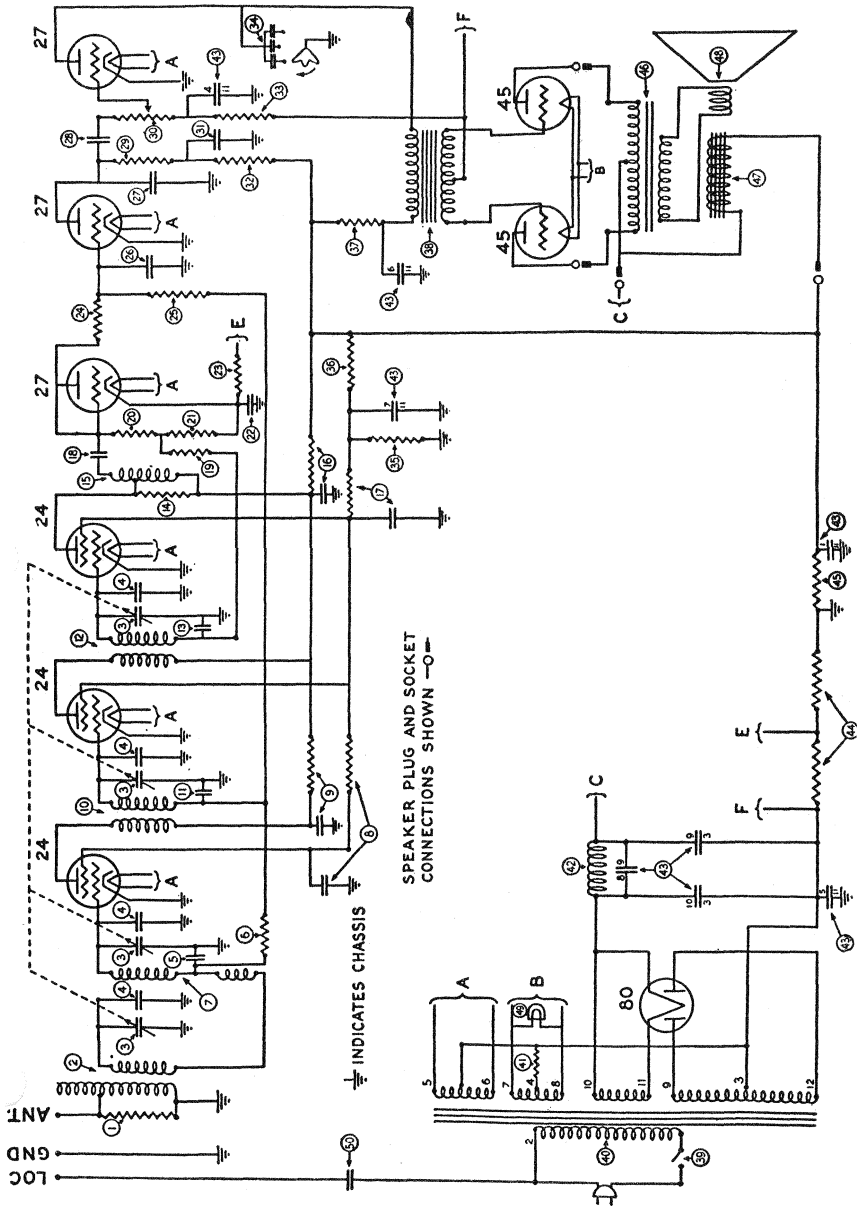
TUBE VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Bias	Cathode Volts	Plate Mill's	Screen Grid
R.F. Stages	224	2.15	155	0	5.3	4	95
Detector	227	2.15	0	—.5	.7	0	—
Det. Amp.	227	2.15	27	—.5	5.5	0	—
1st Audio	227	2.15	85	—2.0	5.5	2.5	—
2nd Audio	245	2.2	250	41	—	28	—
2nd Audio	245	2.2	250	41	—	28	—

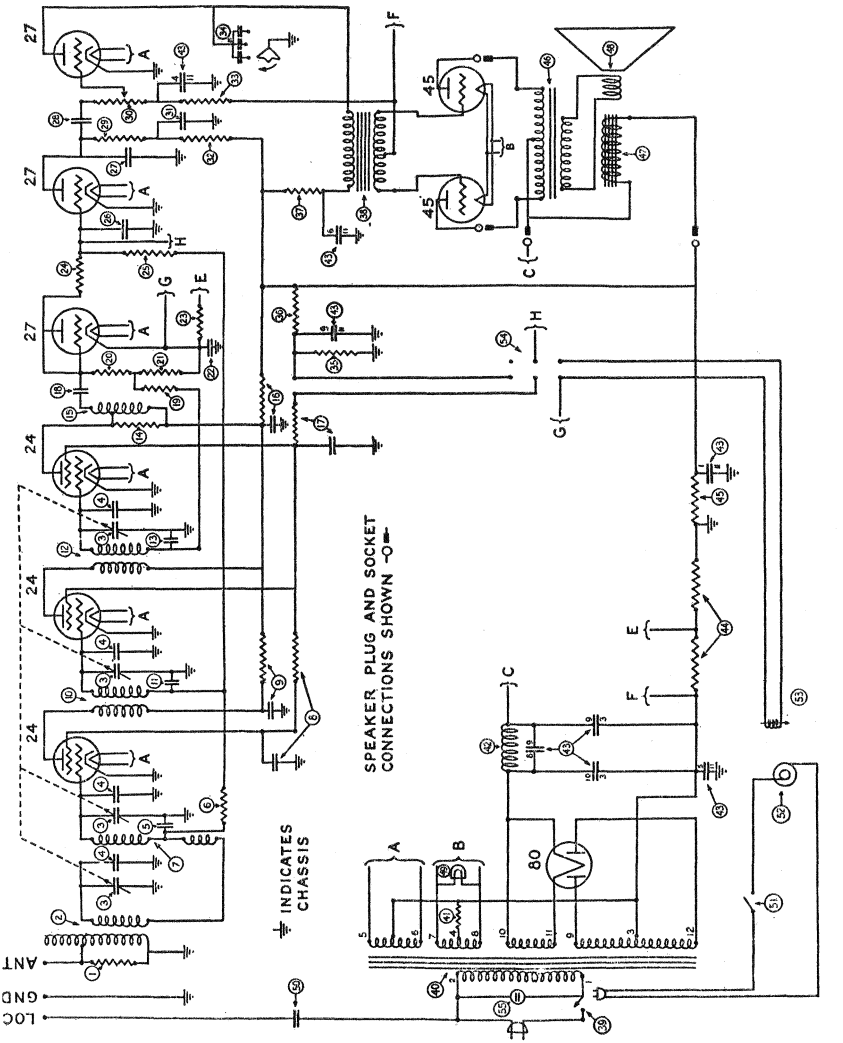
PHILCO — MODELS 296 AND 296A

The chassis of the 296 is the same as that of the 96 except for the extra wiring to the radio-phono switch and the turntable and pick-up. If the pick-up or motor becomes defective, they should be replaced with another and returned to the factory for repairs. Every six months the worm gear of the motor should be greased with clear petroleum jelly, a few drops of thin oil added to the hole above the bearing.

PHILCO MODELS 96 AND 96A



PHILCO MODELS 296 AND 296A



THE PHILCO SCREEN GRID RECEIVER — MODEL 65

The Philco Model 65 is a 5-tube A.C. electric receiver using two stages of tuned R.F. amplification with tubes of the 224 type, a grid bias or power detector with a 227 tube, and a single stage of push-pull audio amplification with type 245 tubes.

The tuning system in the R.F. amplifier consists of an antenna coupler No. 2 and two R.F. transformers No. 7 and 11, all three tuned by a triple condenser, No. 3, 8 and 12. Each section of this condenser is provided with a balancing condenser so that the entire amplifier can be aligned perfectly. No. 4 is another condenser across the first condenser section for compensating for stray capacities introduced in the wiring system of the receiver. The primary of the antenna coupler is shunted by a 10,000-ohm resistor No. 1, but in the later models this has been replaced by a tapped coil with the taps connected to a "local-distance" switch mounted on the panel. The primaries of the two R.F. transformers are wound in two sections so that a uniform amplification gain is had over the entire wave length range.

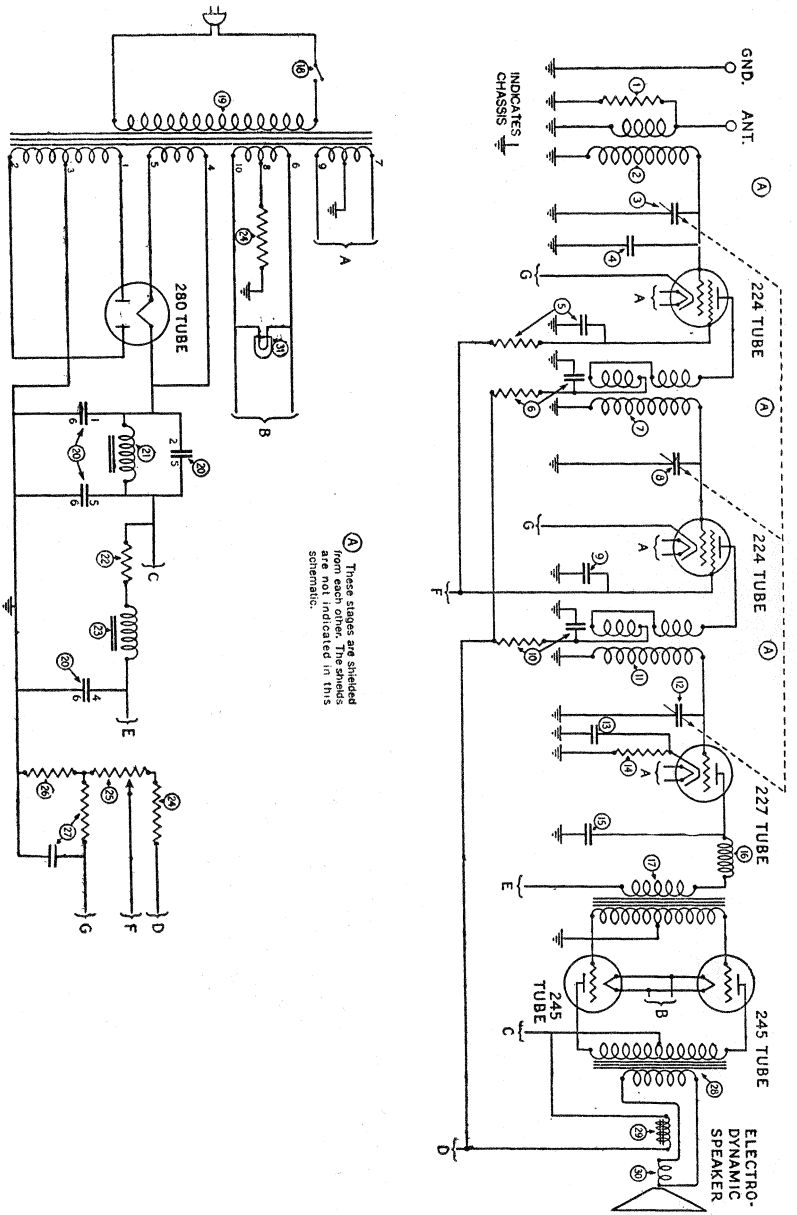
The filaments of the 224 tubes as well as of the 227 detector are supplied with current from a 2½-volt secondary A on the power input transformer. The control grids are connected directly to the stator sections of the tuning condenser. Volume is controlled by means of the variable resistor No. 25 which has a value of 1750 ohms. With this resistor the screen grid voltage can be reduced as low as .2 volt. Filter resistors (250 ohms) are used in the two radio frequency plate leads No. 6 and 10 to suppress any high frequency feedback or oscillations. Suitable bypass resistors are also provided in these lines to form low resistance paths to the ground.

In the detector a 227 tube is used with a grid bias of 28 volts through resistor 14, which is bypassed by condenser No. 13. The detector feeds directly into a push-pull audio stage with type 245 tubes. The grid bias for these tubes is provided by means of the 700-ohm resistor No. 24 connected between the center tap of the filament transformer secondary and the ground, and provides a bias of about 50 volts. A standard output transformer is used to couple the power tubes directly to the voice coil of the dynamic speaker.

Tube	Fil. Volts	Plate Volts	Plate Current	Grid Bias	Cathode	Screen Grid
1st Radio	2.5	150	1.5	1.5	1.5	.2 to 75
2nd Radio	2.5	150	1.5	1.5	1.5	
Detector	2.5	250	.8 to 3.5	28	28	
Power Tubes	2.5	250	32	50		
Rectifier	5.0	355 A.C.	55			

The power unit is of the familiar design employing a type 280 rectifying tube. The in-put transformer has four secondaries, two 2½-volt filament windings, a 5-volt filament winding for the rectifier tube, and a 700-volt center-tapped winding for the plate supply. The outgoing positive line is tapped from one side of the rectifier tube filament and leads through the filter choke No. 21. The circuit then divides, one branch leading to the pos. B terminal on the output transformer and to the field on the speaker, while the other branch goes through the 5000-ohm resistor No. 22 and other filter choke No. 23. From E connection is made to the pos. B terminal of the input transformer to supply plate pressure to the detector tube. The current in flowing through the speaker field experiences enough voltage drop so that current tapped off at D reaches the plates of the radio frequency tubes at a pressure of 150 volts. Resistor No. 24 in the return lead from D has a value of 400 ohms. The screen grid voltage tapped off at F can be varied from .2 to 75 volts by means of the variable resistor No. 25. No. 26 is merely a bleeder resistance.

PHILCO SCREEN GRID RECEIVER—MODEL 65



THE PHILCO SCREEN GRID RECEIVER—Model 76

The Philco Model 67 is a 6-tube A.C. electric set employing two stages of tuned R.F. amplification, a grid bias or power detector, a resistance coupled first audio stage, and a push-pull second audio stage. Screen grid tubes of the 224 type are used in the two radio frequency stages and the detector, a 227 tube in the first audio stage, and two 245's in the second stage.

The tuning system consists of a double-tuned input circuit and two R.F. transformers tuned with a four gang condenser. Two compensating condensers are connected across the gang condenser to balance the first two sections with the last two. All receivers are properly balanced at the factory, and seldom need any changes to be made. In case later on it should be necessary to readjust the settings, a good D.C. oscillator should be used. The balancing should then be done at about 1200 kilocycles, with the volume control turned full on and with a weak oscillator signal.

Volume control is obtained by varying the bias of the control grids of the R.F. tubes by means of resistor No. 30. This permits of a very smooth and uniform operation. A "Local-Distance" switch No. 1 is also provided for use when a powerful nearby station is tuned in. This switch cuts in or out an additional antenna shunt resistance.

In the detector a 224 tube also is used. By the proper grid bias this detector circuit is arranged so that the tube chokes and reduces or cuts off the signal if the volume control is turned up too far on a strong station. This prevents distorted reception after maximum obtainable volume has been reached, for advancing the volume control beyond this point reduces the volume or cuts off the reproduction entirely. If the volume is turned so high that the detector overloads and reduces the signal, two tuning peaks will appear if the station is detuned in each direction. These occur because detuning reduces the signal to the point where the detector no longer overloads, and this causes the volume to increase on each side of the resonant point.

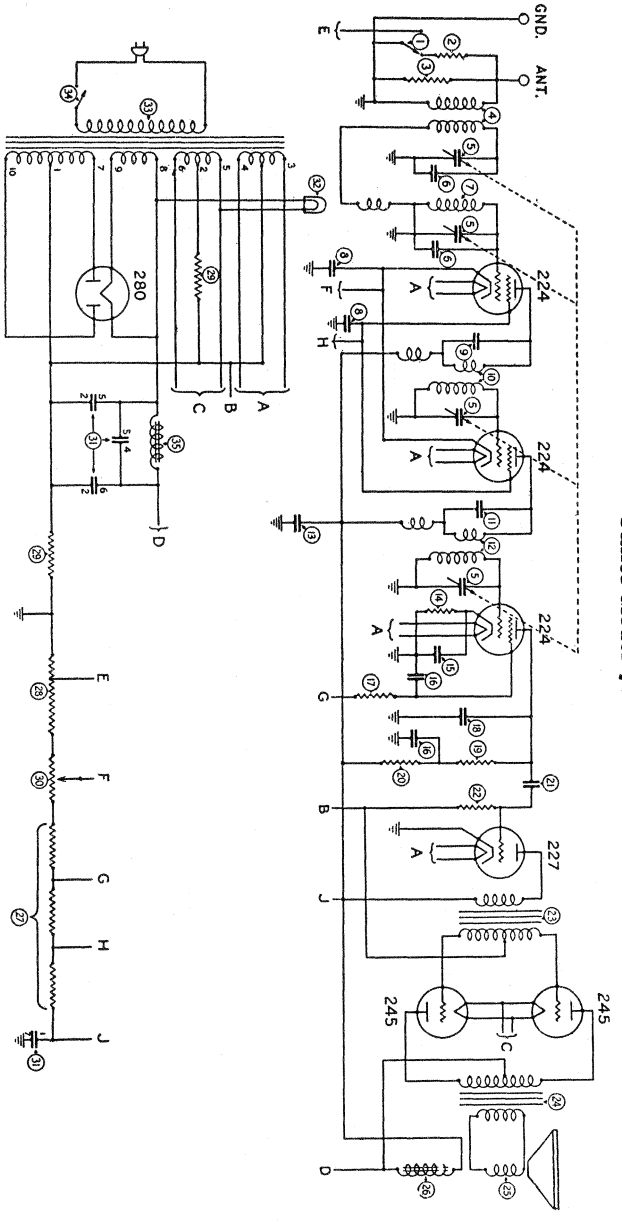
The detector feeds into a resistance-coupled first audio stage in which a type 227 tube is used. Resistor 20 in the detector plate circuit in conjunction with bypass condenser No. 16 serves as a filter for isolating the audio frequency current components. A standard push-pull transformer is used for coupling the two 245 power tubes. The plate circuits of these are coupled directly to the voice coil of the dynamic speaker through a standard output transformer. This transformer is built directly into the speaker, and the speaker is connected to the chassis through a 4-wire cable and plug. Two are plate wires and two serve to excite the field. The plate supply for the power tubes is tapped off at the input side of the field.

Average tube voltages at 115 volts line pressure.

Tube	Filament Volts	Plate Volts	Screen Volts	Grid Bias	Cathode Volts	Plate Mill's	Screen Mill's
1st & 2nd R.F.	2.3	145	90	3	13	3.5	.4
Detector	2.3	36	30	1.4	12	—	—
1st Audio	2.2	140	—	1	10	3	—
2nd Audio	2.2	230	—	46	—	30	—
Rectifier	4.5	—	—	—	—	50	—

In the power unit an input transformer is used with a primary designed for 115 volt A.C. operation and with four secondaries, a 2½-volt winding for the filaments of the 227 and 224 tubes, another 2½-volt winding for the two power tubes, a 5-volt winding for the filament of the rectifier tube, and a 700-volt center-tapped winding for the plate current supply. A single choke and two condensers are used in the filter system. Connections are arranged so that the speaker field also acts as a choke.

PHILCO SCREEN GRID RECEIVER—MODEL 76



THE PHILCO A.C. RECEIVER — MODEL 87

The Philco Model 87 is a 7-tube A.C. electric receiver of the neutrodyne type employing three stages of tuned R.F. amplification, a grid-leak detector, and two stages of audio frequency amplification, the second being push-pull. Tubes of the 226 type are used in the R.F. and first audio stages, a 227 tube in the detector, and two 245's in the push-pull.

The tuning system consists of an antenna coupler and three R.F. transformers, all tuned with a 4-gang condenser. A trimmer or midget condenser is used for tuning the antenna in order to increase the selectivity. The other three condenser sections each have a compensating condenser for matching all the tuned circuits. The main volume control is a 10,000-ohm potentiometer connected between the antenna and ground, with the input to the set connected to the sliding contact. An additional range control is provided in the form of a spring contact on the antenna trimmer condenser. For local stations, this condenser is turned completely to the left where the spring contact closes and disconnects the grid of the first tube from the input circuit and grounds it. For weak signals from distant stations the knob is turned to the right so that the first tube is brought into play and the condenser used for tuning the antenna circuit.

Three terminal posts are provided, Ant., Ground and Loc. The Loc. post can be connected to the Ant. post, and when this is done the antenna circuit is connected through a fixed condenser to one side of the A.C. line. The A.C. attachment plug should be tried each way in the outlet and used in that position in which it gives best results and the least hum.

Special plate resistors (7, 12 and 17) shunted by suitable bypass condensers are used in the plate circuits of the three R.F. tubes. The purpose of these resistors is to isolate the R.F. components of the plate current and return them through the bypass condensers to the ground. The neutralizing condensers are connected between the grid of the tube and a tap on the secondary of the following R.F. transformer. They are accessible through holes in the chassis located to the right of their respective R.F. coils.

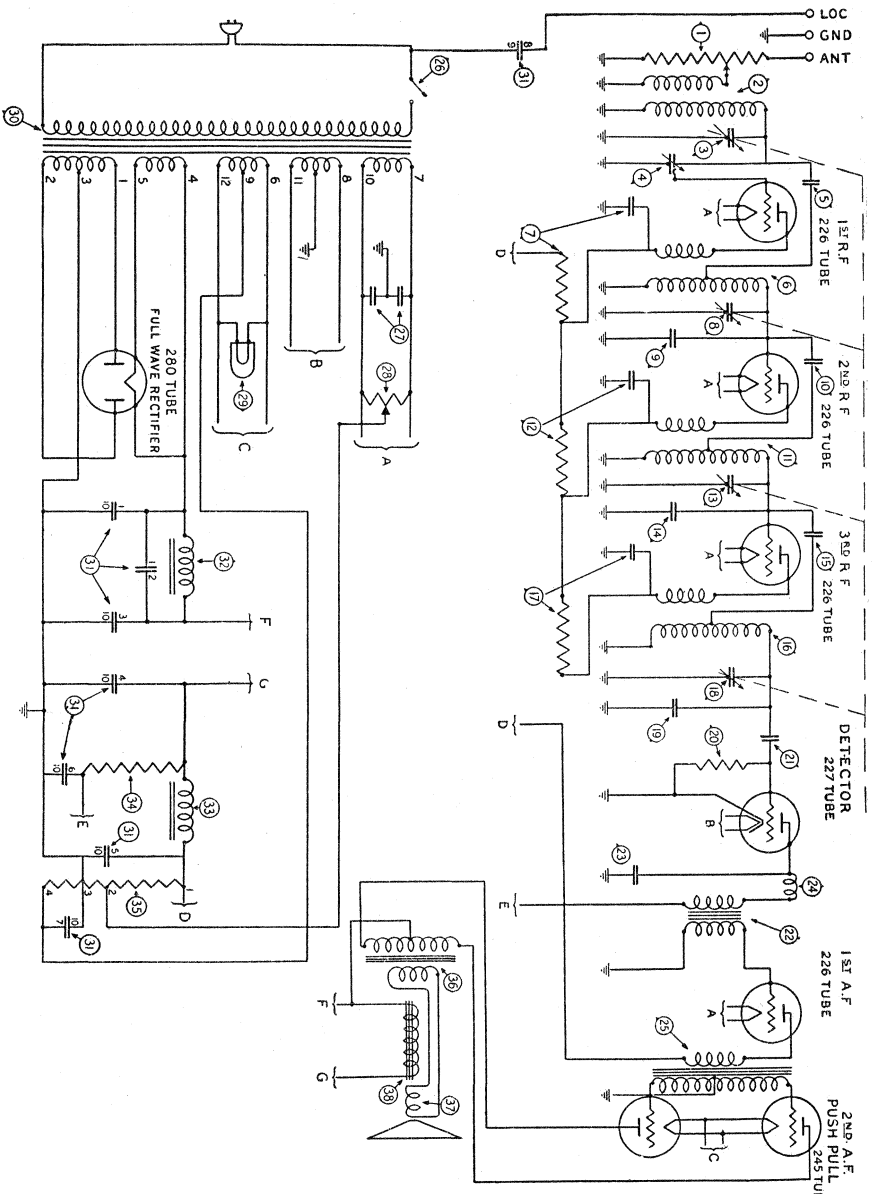
In the detector a standard grid leak and condenser are used, and in the plate circuit an R.F. choke coil (No. 24) and bypass condenser 23. The detector feeds into a transformer-coupled first audio stage using a 226 type tube, and from here the signals are fed through a standard input transformer into the second or push-pull stage using two 245 tubes. The output or speaker coupling transformer is built into the speaker itself, and the speaker is connected to the chassis by means of a 4-wire cable and plug. Two wires in this cable supply the voice coil and two the field. Connection is also made from the input side of the field to the center tap of the transformer for supplying plate current to the two power tubes.

Below are given the readings that should be obtained at the various tube sockets when the set is in operation and all tubes are in their sockets.

Tube	Fil. Volts	Plate Volts	Grid Bias
1st, 2nd and 3rd R.F.	1.5	90	6.0
Detector	2.5	30	
1st Audio	1.5	90	6.0
2nd Audio	2.5	245	45
Rectifier	5.0		

The power supply is equipped with an input transformer that has five secondary windings. The rectifier is a type 280 tube. The filter uses two choke coils in addition to the field of the speaker. Grid bias for the R.F. tubes is obtained through the lower section of resistor 35.

PHILCO A.C. NEUTRODYNE—MODEL 87



THE PHILCO SCREEN GRID RECEIVER — MODEL 95

The Philco Model 95 A.C. receiver employs a double-tuned input circuit that not only eliminates all cross talk, but also renders the antenna very selective and filters out much interference and background noise. This circuit is followed by three stages of R.F. amplification, the first two tuned and the detector input untuned. Three screen grid tubes of the 224 type are used in the R.F. amplifier. A 5000-ohm resistor is connected across the primary of the antenna coupler to flatten any resonance peaks and to insure a more uniform gain over the entire wave length range. A local-distance switch is also provided by means of which another resistor of only 20 ohms is shunted across the antenna primary. When static or interfering noises are excessive, this switch is thrown to the local position. In this condition strong local stations will also tune in more sharply.

The detector circuit is of a novel arrangement in that two type 227 tubes are used. The first of these acts as the detector proper, the plate and grid being connected together. It thus functions as a true two-electrode rectifier. It is absolutely linear in response and free of distorting or blurring. The second 227 is the detector amplifier. Instead of having one detector tube serve two distinct purposes, both rectification and amplification, the work is divided so that the first tube does the rectifying and the second tube provides the amplification.

The automatic volume control is associated with the detector and R.F. amplifier and by means of it the bias voltage of the control grids of the three screen grid R.F. tubes is automatically adjusted in proportion to the strength of the signal, to increase or decrease the radio frequency amplification and hence also the volume output of the receiver.

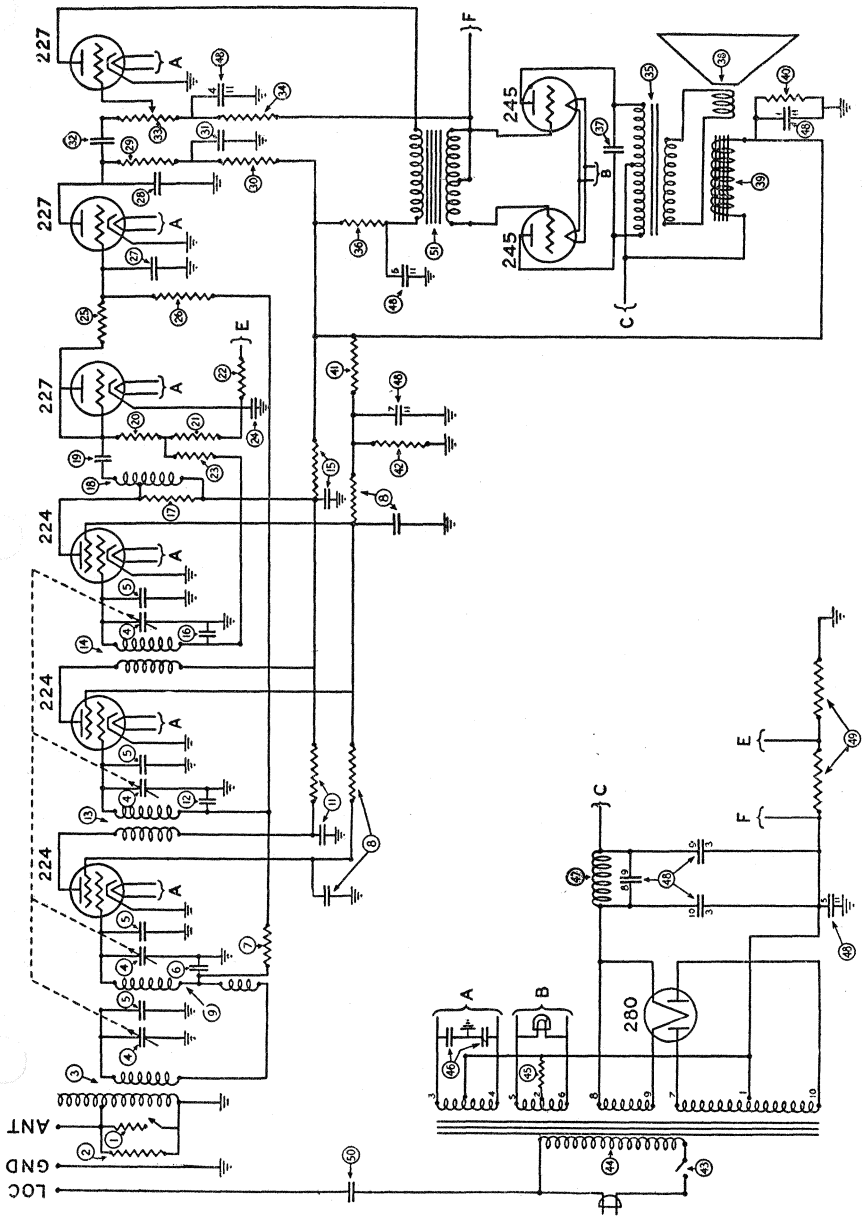
The operation of this automatic volume control is quite interesting. When the receiver is turned on but no station tuned in, the sensitivity is maximum and the set is ready to pick up the slightest signal. Static and interference noises, of course, will be brought in. But as soon as the station signal is tuned in, the automatic volume control comes into play and reduces the sensitivity and volume, the amount depending upon the strength of the signal. This reduction in sensitivity also clears up the static and interference noises, so that during the reception of fairly strong stations, the reception is remarkably clear and free of background noises. The volume of the set should be adjusted to the desired level by means of the volume control rather than by detuning.

There are two audio frequency stages. The first one uses resistance coupling into a 227 tube. The input to the grid of this tube passes through a variable resistor which serves as a volume control. The second audio is a push-pull stage coupled to the first by means of a standard input transformer. Two type 245 tubes are used. The output of these tubes is supplied directly into the voice coil of an electro-dynamic speaker.

AVERAGE TUBE VOLTAGES — A.C. LINE 115 VOLTS

Type Tube	Circuit	Filament Volts	Plate Volts	Screen Volts	Control Grid Volts	Cathode Volts	Plate Milli-Amps.	Screen Grid Mills
280	Rectifier	4.5	—	—	—	—	—	—
224	1st R.F.	2.15	155	95	0	5.3	4	.8
224	2nd R.F.	2.15	155	95	0	5.3	4	.8
224	3rd R.F.	2.15	155	95	0	5.3	4	.8
227	Det.	2.15	0	—	—.5	.7	0	—
227	Det. Amp.	2.15	27	—	—.5	5.5	0	—
227	1st A.F.	2.15	85	—	—2.0*	5.5	2.5	—
245	2nd A.F.	2.2	250	—	41	—	28	—

PHILCO SCREEN GRID RECEIVER—MODEL 95



MAJESTIC MODELS 71 AND 72

The Majestic Models 71 and 72 are A.C. electric receivers and were among the first to employ the R.F.L. balanced circuit for A.C. tubes. There are three tuned R.F. stages with tubes of the 226 type, a detector with a type 227 tube, a first audio stage with a 226 tube, and a second audio stage with two type 171A tubes in push-pull. The receiver consists of two parts, the chassis itself and the power unit. The chassis in turn is built up of five units or sub-assemblies.

The coupling circuit between the antenna and first tube is of unique design in that it is a combination input and volume control. A 10,000-ohm variable resistor is connected across the antenna and ground, the antenna end being connected through a tuned coil to the grid of the first tube. The inductance of the tuned coil is varied by means of a metal cap which slides over the coil. This cap thus forms an antenna trimmer or selectivity control. The variable resistor controls the amount of input to the first tube, but the arrangement is such that all R.F. tubes can always operate at maximum efficiency.

The necessary grid bias for the three R.F. tubes is obtained by grounding the grids of the tubes through the R.F. coils and placing a positive potential on the filament. This is accomplished by connecting the center tap of a 20-ohm filament resistor through a 550-ohm biasing resistor to the ground. Similarly the grid of the first audio is biased by grounding the center tap of its filament resistor through a 1400-ohm resistor. All parts of the filament and plate circuits are bypassed to ground by .5-mfd condensers.

In the detector circuit a .00025-mfd. condenser and 2-meg. grid leak are used in the customary manner. The output of the detector is coupled to the first audio tube through a standard audio transformer. A type 226 tube is used. This tube is then coupled through a push-pull input transformer to two 171A tubes. The output of these tubes is then supplied directly to the voice coil of the dynamic speaker through a standard output transformer.

A separate power unit is used housed in an individual container. This unit contains two input transformers, one for the filament supply and the other for the high voltage plate supply. The filter circuit has two chokes and two filter condensers in addition to the voltage dividing resistor with its bypass condensers. A ballast resistor is used in series with the A.C. line and the two transformer primaries in order to maintain a constant voltage input, even though the line voltage may vary considerably.

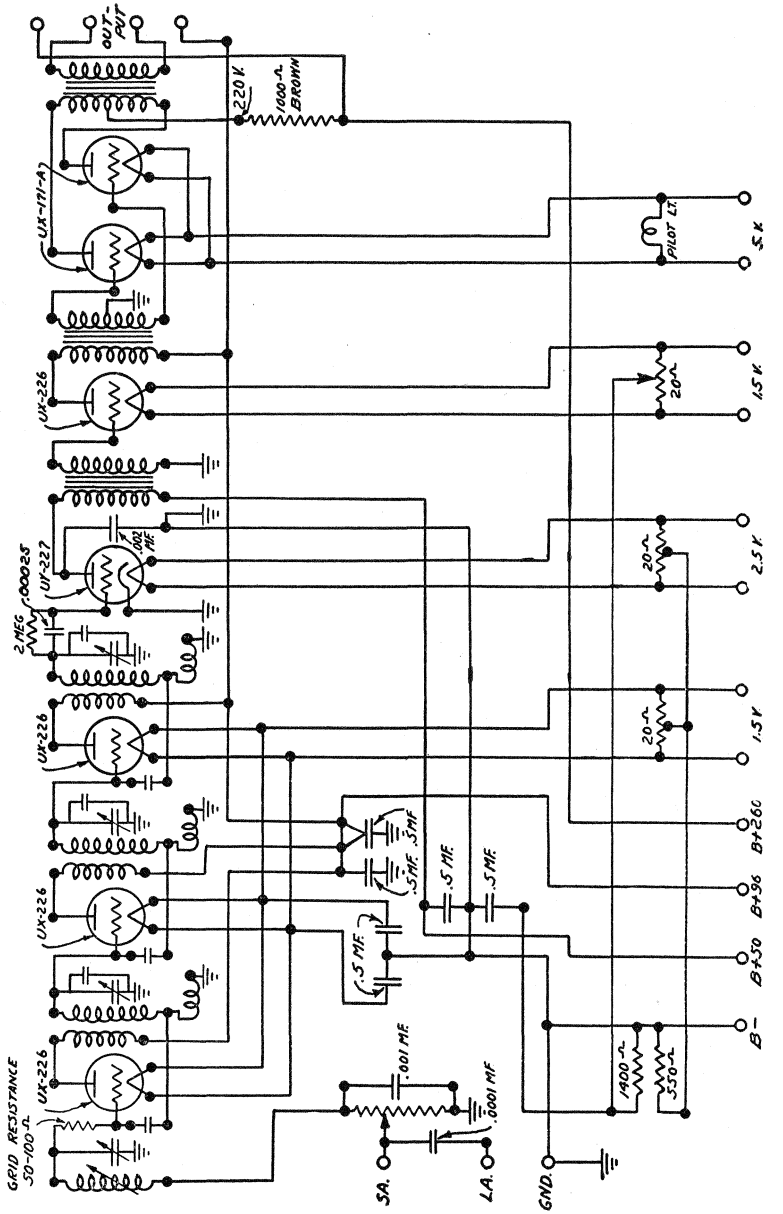
The speaker used is of the electrodynamic type with the field connected so as to form an additional choke for the filter system. In the model G-1 used in the No. 70 chassis the field has a resistance of 3100 ohms, while in the 70B chassis the model G-2 speaker is used which has a resistance of 2730 ohms. No adjustments of any kind are necessary with these speakers. If the speaker should require service attention, the regular method of procedure can be followed.

Average socket voltage — Line voltage at 112.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's
1st R.F.	226	1.4	96	5	3.5
2nd R.F.	226	1.4	96	5	3.5
3rd R.F.	226	1.4	96	5	3.5
Detector	227	2.2	40	0	3.0
1st Audio	226	1.4	83	4	3.5
2nd Andio	171A	4.8	180	40	20.
Rectifier	280	4.8	—	—	—

Chasses 70 and 70-B are alike except that they have a different speaker and the 70-B has a 1000-ohm resistor in series with the plate circuit of the output transformer.

MAJESTIC A.C. RECEIVER—MODELS 71 and 72



THE MAJESTIC MODELS 91 AND 92

The Majestic Models 91 and 92 are seven tube A.C. electric receivers employing the R.F.L. balanced circuit. There are four tuned R.F. stages with tubes of the 227 type, a power detector with a 227 tube, and a single audio stage with two type 245 tubes in push-pull. The receiver assembly is built up of three units, one containing the R.F. transformers, bypass condensers, sockets and chokes, the second containing the tuning condenser, dial and equalizer, and the third housing the power apparatus.

An R.F. choke shunted by a .001-mfd fixed condenser is connected across the antenna and ground, and the antenna itself is connected to the grid of the first tube through a tuned coil. The inductance of this coil is varied by means of a metal cup that slides over it and that at the same time constitutes the antenna trimmer or selectivity control. The antenna coil as well as the four R.F. transformers are tuned by means of a 5-gang condenser. The cathodes of the first three tubes are connected together and brought to ground through two variable resistors connected in series. The first is a 75,000-ohm unit and serves as a volume control. It is operated with a knob on the front panel. The second unit has a resistance ranging from 500 to 2500-ohms and varies the grid bias of the first three tubes. It is mounted on the end of the main condenser shaft, and as the receiver is tuned the R.F. bias is varied so that the sensitivity is maintained practically uniform over the entire range. The cathode of the fourth R.F. tube is grounded through an individual 1800-ohm biasing resistor. Bypass condensers of 0.5-mfd. are used in the various cathode and plate circuits.

In the detector circuit plate rectification is employed, which is effected through the use of a 35,000-ohm cathode biasing resistor. This places a negative bias of 30 volts on the grid, the plate pressure employed being 270 volts. An R.F. choke is used in the plate circuit to keep the high frequency currents out of the audio system, while a .004 mfd condenser provides a low resistance return to the cathode or ground.

The detector feeds directly into a push-pull audio stage through a standard input transformer. Type 245 tubes are used with a plate pressure of 250 volts and a grid bias of 50 volts obtained through an 800-ohm resistor connected between a filament center tap and the ground. This resistor is contained in the power pack.

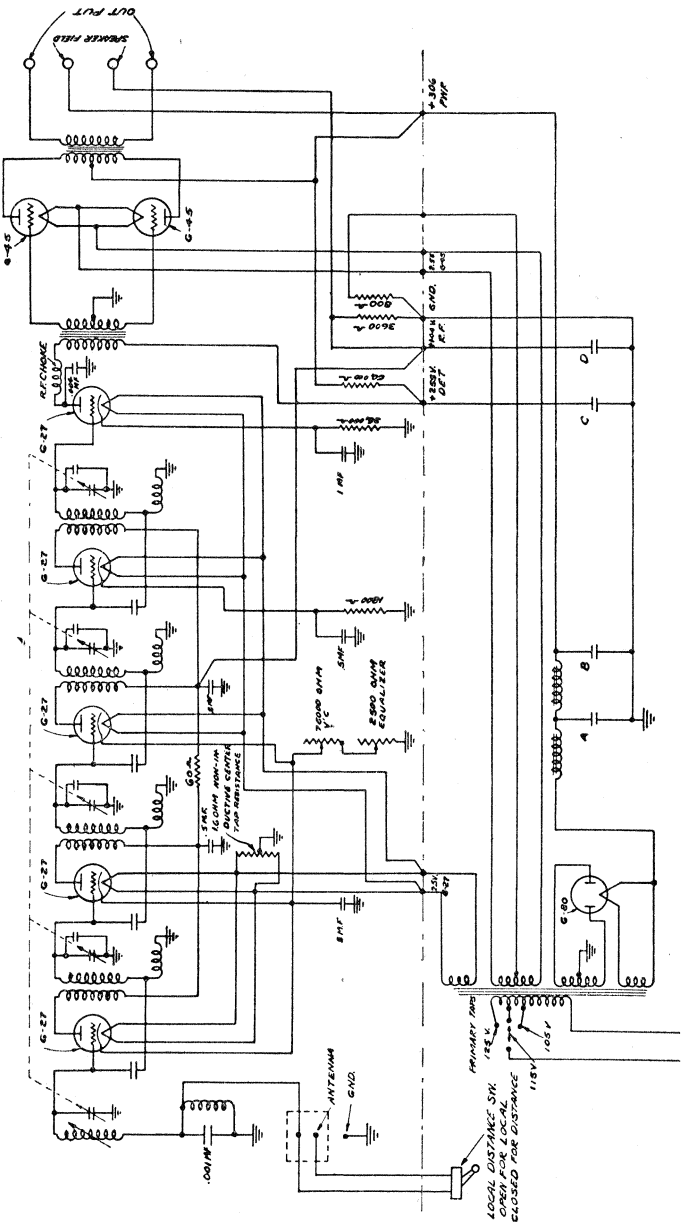
The power supply system contains an input transformer with a ballast resistor in series with the primary winding and A.C. line in order to maintain a constant voltage input. The transformer also has three filament secondaries and a high voltage plate secondary. A type 280 full wave rectifier is used. The filter system consists of two 220-ohm choke coils and two 2-mfd. condensers. The field of the dynamic speaker is also used as a choke in the filter system, and its resistance of 2730 ohms is used to lower the voltage which is supplied to the plate circuit of the R.F. tubes.

Average tube voltage at 115 volts line pressure.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's
1st R.F.	'27	2.35	130	8	5.5
2nd R.F.	'27	2.35	130	8	5.5
3rd R.F.	'27	2.35	130	8	5.5
4th R.F.	'27	2.35	130	9	5.0
Detector	'27	2.35	270	30	1
Audio	'45	2.45	250	50	32

Under no conditions attempt to operate the set with a ground connection on the antenna binding post, as this will cause distortion and destroy tone quality.

MAJESTIC A.C. RECEIVER—MODELS 91 and 92



THE BOSCH A.C. RECEIVER — MODEL 28

The Bosch Model 28 is a table model A.C. electric receiver employing a 3-stage R.F. amplifier with tubes of the 226 type, a grid leak detector with a type 227 tube, a first audio stage with a type 226 tube, and a second audio stage with two type 171A tubes in push-pull. The receiver itself and the push-pull power pack are built as two separate units, but are assembled in a single cabinet.

The receiver is provided with an antenna lead (brown with blue tracer) of sufficient length to reach to the lead-in strip or indoor aerial, and has connected at its end a small fixed condenser. For a long antenna, 60 to 100 feet, connection is made to the free end of the condenser; while for a shorter aerial, 30 to 60 feet, the condenser is removed and connection is made to the free end of the antenna lead. It is very important that the receiver be at all times well grounded in order to prevent anyone from receiving a shock when coming in contact with any internal parts of the receiver.

The tuning system consists of an antenna tuning variometer and three R.F. transformers, all tuned with a 4-gang condenser. Individual aligning condensers connected in parallel with the main tuning condenser are also provided for bringing the successive stages into perpect synchronism. The balancing condensers are connected between the socket grid contact and the tap on the secondary coil. Seldom, however, need these be adjusted. The variometer is separately operated, and serves to tune the antenna to the wave length of the station selected. It is commonly referred to as the clarifier, and also helps to increase the selectivity of the receiver at the higher frequencies. The biasing resistors for the various tubes are all built into the power pack unit. The grid returns of the three R.F. tubes as well as the detector are brought directly to the grounded chassis.

The volume control consists of a high resistance potentiometer across the input to the first radio frequency stage. It is mounted in the first condenser compartment and is operated by means of a belt from the control knob on the front panel. It is electrically connected between the stator of the R.F. condenser and the ground, the movable arm being connected to the grid of the first R.F. tube. To check the volume control, tune the receiver to a distant station, turn volume fully on, and disconnect the ground terminal of the potentiometer. If the volume increases materially, the unit is defective.

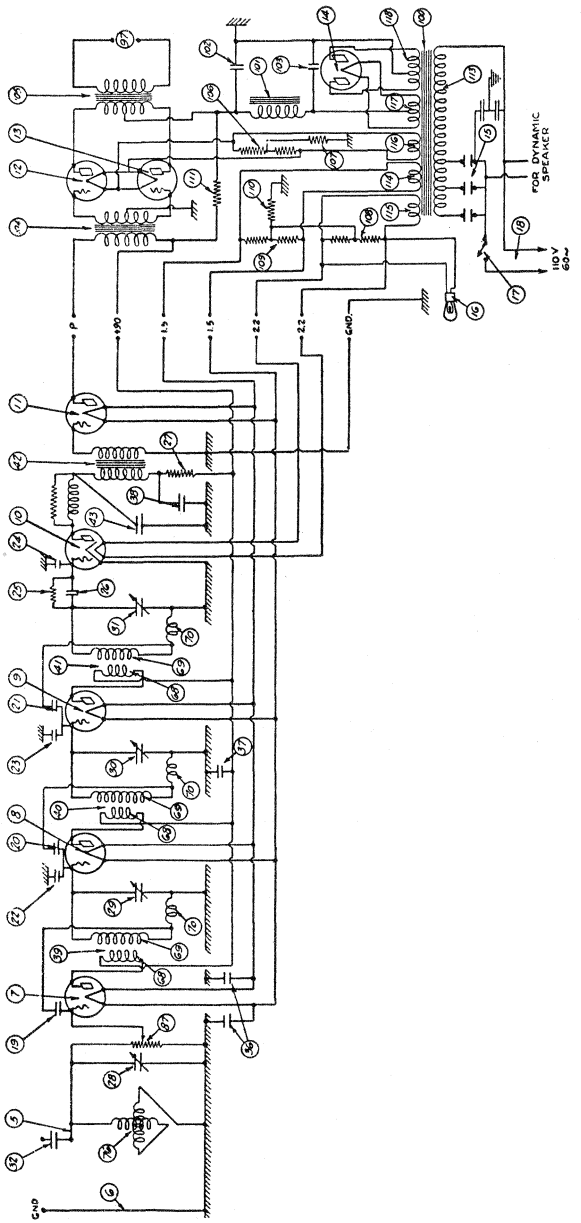
In the detector circuit the familiar grid leak and condenser arrangement is used. In the plate circuit a shielded choke coil is used shunted by a 2000-ohm fixed resistor. This arrangement increases the sensitivity of the receiver on the upper wave lengths (higher frequencies) and renders the response of the set practically constant over the entire wave length range. The output of the detector is supplied through a standard audio transformer to the first audio amplifying tube, and this tube in turn is coupled to the two 171 A's in push-pull through a standard input transformer. The output of these tubes is supplied to a magnetic cone speaker through an output transformer.

The following are average socket voltages.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mills
1st, 2nd and 3rd R.F.	226	1.3	100	7	4
Detector	227	2.3	45	—	2
1st Audio	226	1.3	100	7	3
2nd Audio	171A	5	150	35	10

The power supply system is of standard design. Across the incoming A.C. lines is connected a filter consisting of two suitable condensers in series with their common point grounded. The input transformer has a tapped primary to take care of different line voltages, and five secondary windings. A type 280 rectifying tube is used.

BOSCH A.C. RECEIVER—MODEL 28



The BOSCH SCREEN GRID RECEIVER—Model 48 & 49

The Bosch Model 48 is an A.C. screen grid receiver with an R.F. amplifier that employs three type 224 tubes, a power detector with a 227 tube and a single audio stage with two 245 tubes in push-pull. There are four tuned circuits, an antenna tuner and three transformer coupled R.F. stages. The antenna tuner consists of a variometer that is tuned synchronously with the condenser gang by means of reduction gears. This tuning system permits of uniform sensitivity over the entire wave length range. In parallel with the variometer is a midget trimmer condenser which serves as a clarifier or antenna tuner. The antenna is connected to the sliding contact of a 10,000-ohm potentiometer which serves as one section of a dual volume control.

The three successive R.F. stages are coupled by means of shielded transformers that are tuned with a three-gang condenser. The cathodes of the three R.F. tubes are grounded through individual biasing resistors of 1500 ohms each. The screen grid of the first tube is connected to the voltage divider through a grounded potentiometer which serves as the other section of the volume control by varying the voltage of the screen grid from 70 to 0. The screen grids of the second and third tubes are connected directly to the same voltage divider tap. Resistors of 500 ohms are used in the grid circuits of the second and third tubes.

The power detector employs a type 227 tube, plate rectification being effected by means of a 15,000-ohm cathode biasing resistor shunted by a 1-mfd bypass condenser. A plate pressure of 290 volts is employed. The plate circuit employs the customary R.F. filter consisting of a choke coil bypassed on each side to ground by a .001-mfd. condenser.

Advantage is taken here of the high detector output by using only one audio frequency stage, consisting of a pair of 245's in push-pull coupled to the detector through a standard input transformer. A standard output transformer is also used which feeds directly into the voice coil of the dynamic speaker. This output transformer is mounted on the set chassis itself. The center-tap of the input transformer is grounded, and the necessary grid bias is obtained by means of a biasing resistor connected between a center-tapped filament resistor and the ground. The biasing resistor is a part of the regular voltage divider resistor.

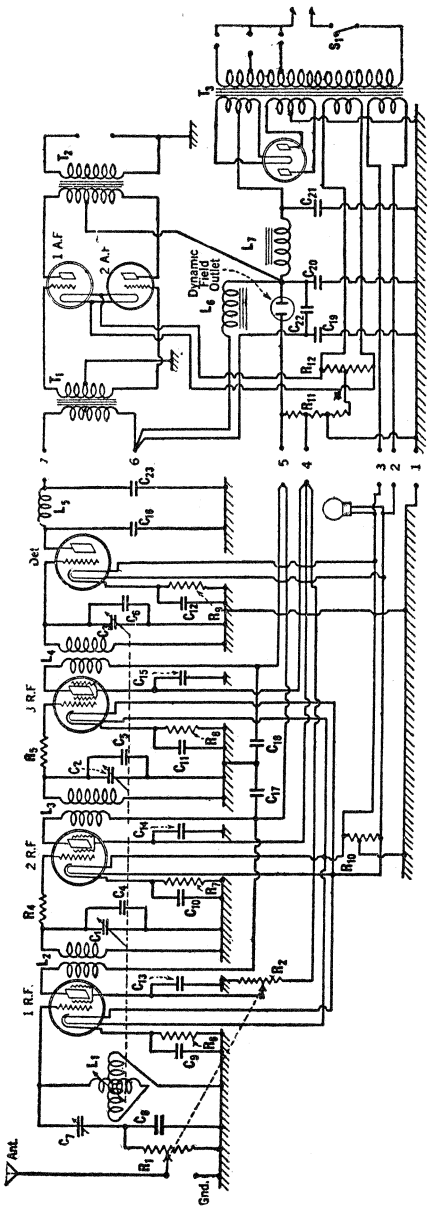
Correct socket voltages at 115 volts line pressure.

Tube	Filament Volts	Plate Volts	Grid Bias	Scree Volts	Plate Mills
1st R.F.	2.4	175	2.5	70	3.5
2nd R.F.	2.4	175	2.5	70	3.5
3rd R.F.	2.4	175	2.5	70	3.5
Detector	2.4	290	27	—	2.0
1st and 2nd Audio	2.4	250	45	—	30
Rectifier	4.8	—	—	—	55

In the 25-cycle model 49 the plate pressure on the R.F. tubes is only 150, on the detector 250, and on the 245's only 200 volts. The corresponding grid bias of the R.F. tubes is then 1.5 volts, and for the 245's only 42 volts. All the other values are the same.

The power supply is of standard design and employs an input transformer with a tapped primary and four secondaries, three filament windings and a high-voltage center-tapped winding. The filter consists of a choke and three filter condensers of 4, 4 and 2 mfds. A .05-mfd. condenser is shunted across the coil. The speaker field winding also serves as a filter choke. Another choke coil and 1-mfd condenser are used in the detector plate lead to further eliminate all hum ripples. The pilot light is connected across the R.F. filament circuit. A center-tapped resistor with the tap grounded is also connected across this circuit.

BOSCH SCREEN GRID RECEIVER—Models 48 and 49



THE KENNEDY NEUTRODYNE—MODEL 10

The Kennedy No. 10 receiver is a 7-tube set employing a balanced circuit of the neutrodyne type. It consists of a 3-stage R.F. amplifier with tubes of the 227 type, a detector and transformer coupled first audio stage both using 227 type tubes, and a push-pull audio stage with power tubes of the 245 type.

All three R.F. stages as well as the detector are tuned with a 4-gang condenser, no trimmings being provided as the entire amplifier is perfectly adjusted and aligned at the factory. Between the R.F. tube shields are small holes in the chassis through which the neutralizing condensers can be reached with an insulated screw driver. Each condenser is in front of its respective tube. Volume is controlled by means of a variable resistor in the B-supply which regulates the voltage supplied to the plates of the R.F. tubes.

There are two main controls, a tuning control on the right and volume control on the left. Between the two is a small lever, the Radio-Phono switch. When this lever is moved to the right, the phonograph pickup is connected across the grid and cathode of the detector tube, but when it is to the left the pickup is entirely out of the circuit. The receiver volume control does not operate for phonograph reproduction. Directly below the phono switch is the A.C. "on-off" switch that controls the entire receiver.

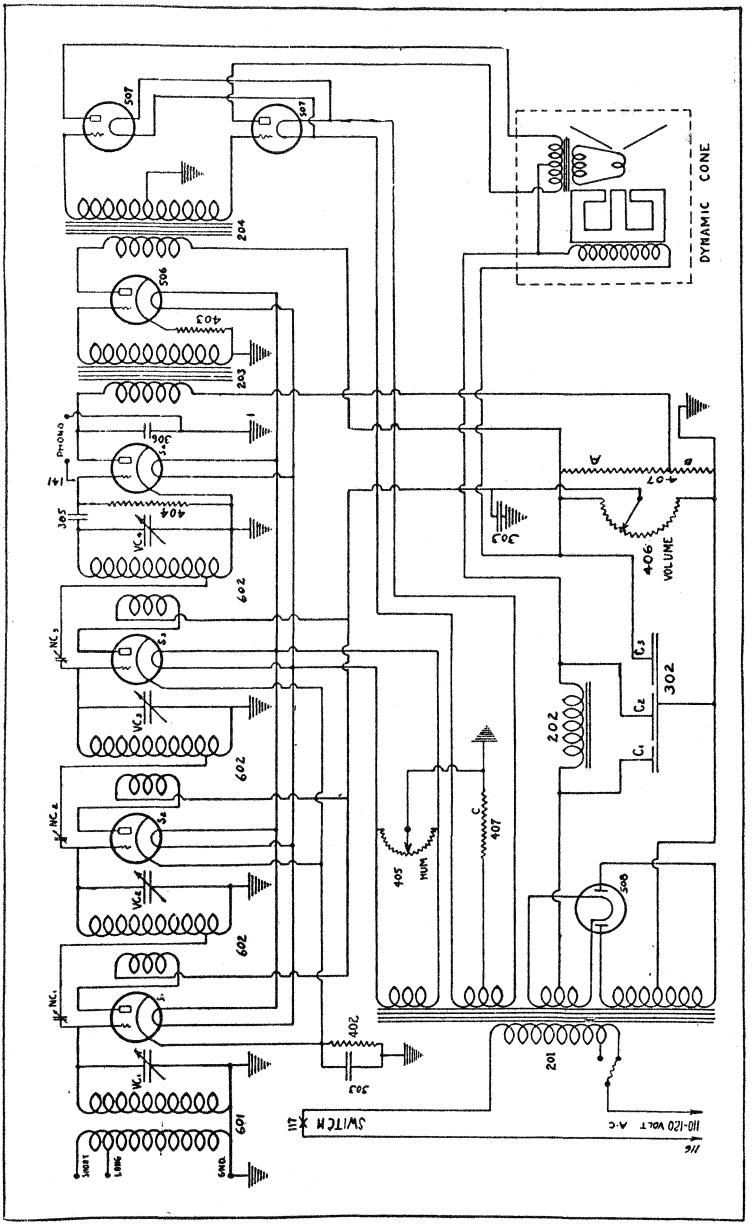
The power system consists of an input transformer, a full wave type 280 rectifying tube, a filter choke and electrolytic filter condenser, and voltage dividing resistor. The field of the dynamic speaker also serves as a filter choke.

In the following table is a typical set of voltage readings taken on a receiver in operation and all tubes in their sockets. The line voltage used was 115 volts.

Tube	Filament	Plate	Bias
First R.F.	2.37	115	7.5
Second R.F.	2.37	115	7.5
Third R.F.	2.4	115	7.5
Detector	2.37	34	—
First A.F.	2.41	110	6.5
Power Tubes	2.43	225	4.5
Rectifier	4.82	—	—

In case of trouble the general directions for service procedure given in previous bulletins can be followed. If the antenna, ground and tubes are in good condition, a check-up of all voltages and biases taken at every tube socket with a set tester will quickly reveal the cause of the trouble if it is due to a failure of the power supply or its associated parts. If it is necessary to take out the chassis, this can be done by removing the two control knobs in front, pulling out all terminal connections in the rear, and removing the four hold-down bolts at the corners of the chassis. Access to the various circuits and parts can then be gained by removing the base plate. When making any repairs, it is very important that none of the wires be changed any in position or length, for this is likely to alter the general stability and balance of the various parts. If any replacement parts are needed, these can be obtained from the factory by supplying the chassis serial number. The address is, Colin B. Kennedy Corporation, South Bend, Indiana. Lack of selectivity is often due to the use of the wrong antenna terminal post, and improved results can frequently be obtained by changing from the long to short antenna post or vice versa. If it is necessary to replace an R.F. coil, a complete set if coils should be procured from the factory so that a perfectly matched set will be used.

KENNEDY A.C. NEUTRODYNE—MODEL 10



THE KENNEDY SCREEN GRID RECEIVER—Model 20

The Kennedy Model 20 receiver is a 7-tube set employing a three-stage radio frequency amplifier with tubes of the 224 type, a grid bias or power detector with a 227 tube, a resistance coupled first audio stage with a 227 tube, and a push-pull audio stage using two type 245 tubes. The entire receiver is of very rugged mechanical construction and all parts including the coils and screen grid tubes are individually shielded.

The receiver has two main controls, on the right a tuning control and on the left the volume control. Below these is the "on-off" switch and above the switch is a lever that can be moved to the right or left, to the left for radio reception and to the right for phonograph reproduction. In the latter position the connection from the detector coil to the ground is broken and the phonograph pick-up is connected in series with the detector coil. When the lever is thrown to the left, the pick-up is entirely out of the circuit. Three terminal posts are provided, Ground, Long Antenna, and Short Antenna. Often when lack of selectivity is experienced, this can be corrected by changing antenna posts.

The three R.F. transformers and detector are tuned with a 4-gang condenser. No trimmers are provided as everything is perfectly aligned at the factory. Three 3-in-1 bypass condensers are used for bypassing the cathode, screen grid and plate circuits to ground. An adjustable hum control (20-ohm potentiometer) is connected across the filament circuit. Volume is controlled by varying the voltage applied to the screens of the R.F. tubes.

The power unit consists of a transformer that provides the necessary voltages, a type 280 rectifier tube, a filter choke and electrolytic filter condenser, and voltage divider resistance. The field of the dynamic speaker also serves as a filter choke. The output transformer of the last audio stage is built into the dynamic speaker, and a common wire supplies the speaker field and the power tube plate current through the output transformer.

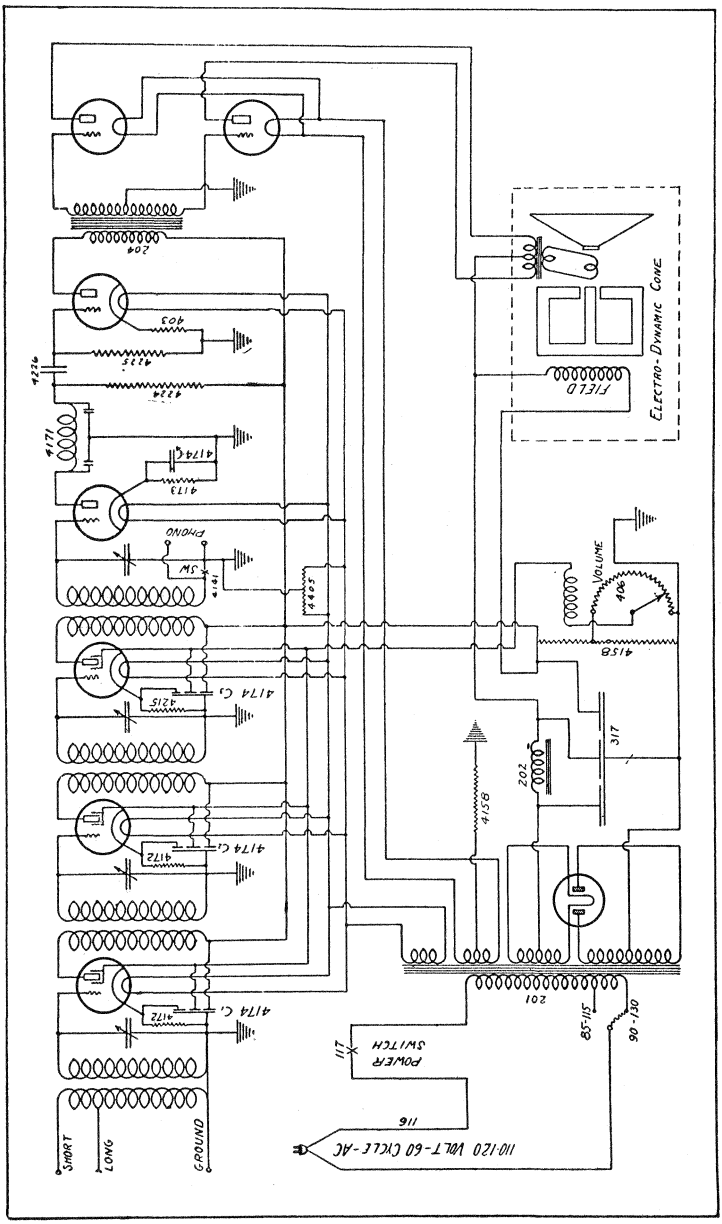
The following is a typical set of voltage readings taken on a receiver with the volume control full on and all tubes in their sockets.

Tube	Filament	Plate	Bias	Screen
First R.F.	2.3	170	3.5	65
Second R.F.	2.3	170	3.5	65
Third R.F.	2.3	170	3.5	65
Detector	2.3	125	16	65
First A.F.	2.3	156	9	—
Power tubes	2.35	230	46	—
Rectifier	4.8	—	—	—

If a set oscillates and the shielding is in place and firmly grounded and all tubes are known to be good, it can be stabilized in two ways. A special tap is provided on the voltage divider so that a lower voltage can be applied to the screens if it is necessary or desirable. These lower screen voltages will generally stop the oscillations. Also, the R.F. tubes have individual biasing resistors, and by replacing one or more of these with some of higher resistance, the oscillations can be controlled.

If it is necessary to remove the chassis from the cabinet, this can be done by removing the connections from the rear terminals, clearing the A.C. cord, removing the two bakelite control knobs, and taking out the four hold-down bolts in the corners of the chassis. Testing of all voltages and continuity of circuits and parts can then be easily done by turning the set bottom side up and removing the base plate so that all wiring and parts terminals are exposed. However, the position or length of any wires should not be altered as this is likely to upset the stability and balance of the various circuits.

KENNEDY SCREEN GRID RECEIVER—MODEL 20



THE KOLSTER MODEL K-43

The Kolster Model K-43 is a 7-tube A.C. electric receiver with a 3-stage R.F. amplifier employing type 224 tubes, a grid leak detector and transformer coupled first audio stage each using a type 227 tube, and a second audio stage using two type 245 tubes in push-pull.

The tuning system consists of an antenna coupler and three R.F. transformers all tuned by means of a 4-gang condenser. Across the primary of the antenna coupler is connected a 25,000-ohm potentiometer in series with a .0001-mfd. condenser. This potentiometer serves as one section of a dual volume control by regulating the antenna input. The other section is a 10,000-ohm variable resistor for regulating the voltage supplied to the screen grids of the first three tubes. In the plate circuit of the first screen grid tube is a 10,000-ohm resistor shunted by a 50-mfd. condenser to suppress any tendency toward oscillation. The grid returns of the R.F. tubes are brought directly to the ground, while the grids are biased negatively 1½ volts by returning the three cathode leads through a 380-ohm resistor.

The detector is of the standard grid leak and condenser type. The cathode is returned directly to the ground, and in the plate circuit an R.F. choke and .002-mfd. condenser are used to keep the high frequency currents out of the audio system. A standard transformer is used to couple the first audio tube, and across the primary of this transformer is a suitable jack for plugging in a phonograph pick-up. A 250,000-ohm resistor shunted by a 1-mfd. condenser is used as a filter in the grid circuit of this audio tube. The cathode is grounded through a 3000-ohm resistor which biases the grid 6 volts negatively. A standard input transformer is used to supply the second audio stage which uses two 245's in push-pull. The output transformer is built directly into the speaker and is connected to the chassis of a two-wire cable. A 2.5 volt pilot lamp is connected across the filament circuit of the first five tubes.

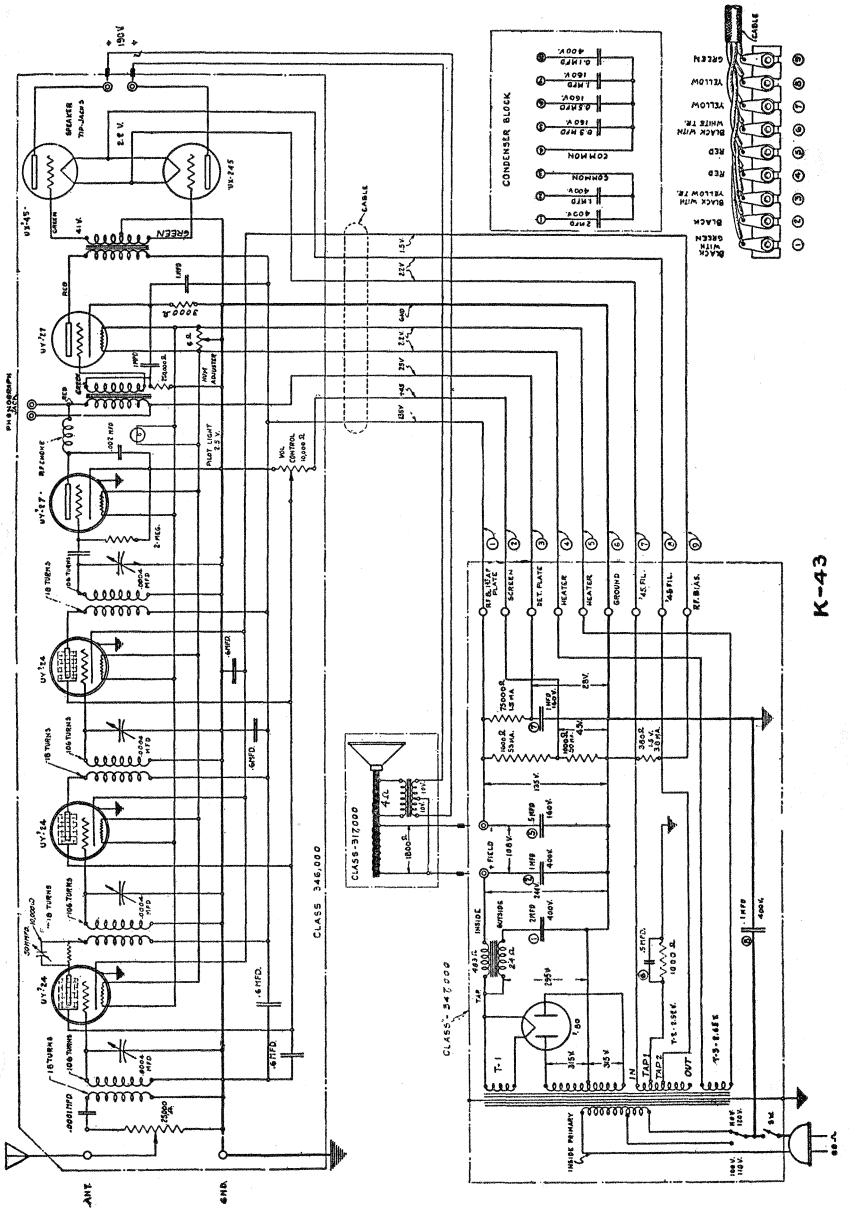
The power supply unit is of standard design. The input transformer has a tapped primary winding and four secondaries, a filament winding for the 280 rectifier tube, a 630-volt plate supply winding, a 2.5-volt filament winding for the amplifier tubes, and a 2.5-volt filament winding for the power tubes. The last winding also has a third terminal brought out so that it can be used as a 5-volt winding for two 171A power tubes in the push-pull output stage. The first filter choke is provided with a secondary which forms a sort of absorption or stabilizing circuit. The speaker field winding serves as a second filter choke. A parallel-series voltage divider is used to provide the various voltages needed. The filter condensers are of liberal capacity to absorb as much as possible of the A.C. hum.

Average tube voltages at 120-volt line pressure.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's	Screen Volts
1st R.F.	224	2.15	125	1.5	1.3	45
2nd R.F.	224	2.15	125	1.5	1.2	45
3rd R.F.	224	2.15	125	1.5	1.4	45
Detector	227	2.2	25	0	1.5	—
1st Audio	227	2.2	105	6	4	—
2nd Audio	245	2.2	190	40	21	—
Rectifier	280	5.0	315	—	—	—

The antenna to be used with this receiver need not normally exceed 50 feet in length including the lead-in. If local conditions are not favorable for the use of a short aerial, an aerial as long as 150 feet can be used. But in such cases a .0001 or .00025-mfd. condenser should be used in series with the aerial lead-in so as to loosen the aerial coupling somewhat. If 171A tubes are used in the output stage, no changes in the plate or bias voltages are necessary.

KOLSTER SCREEN GRID RECEIVER—MODEL K-43



THE KOLSTER A.C. RECEIVER — K-44

The Kolster Model K-44 is an A.C. screen grid receiver that employs three stages of tuned R.F. amplification with tubes of the 224 type, a detector and first audio stage with type 227 tubes, and a second audio stage with two type 245 tubes in push-pull. The receiver has great sensitivity and is capable of delivering large volume without distortion.

The tuning system consists of an antenna coupler and three R.F. transformers, all tuned with a 4-gang condenser each section of which is provided with a trimmer for phasing purposes. The primary of the antenna coupler is shunted by a 25,000-ohm variable resistor which serves as one section of a dual volume control by regulating the amount of antenna energy that is impressed upon the grid of the first tube . The other section of the volume control is a variable resistor in the screen grid circuit for regulating the voltage applied to these elements. The remainder of the R.F. amplifier is of standard design.

In the detector which employs a type 227 tube plate rectification is employed by returning the cathode to the ground through a suitable resistor. In the plate circuit an R.F. choke coil and .001 bypass condenser are used to keep the high frequency currents out of the audio system. A phono-radio switch is also employed here. When the switch is in the radio position, the detector output is connected across the entire primary of the first audio transformer, but when it is in the phono position the pick-up is connected across only half of the transformer primary. The reason for this is that a better matching of impedances is obtained in this manner.

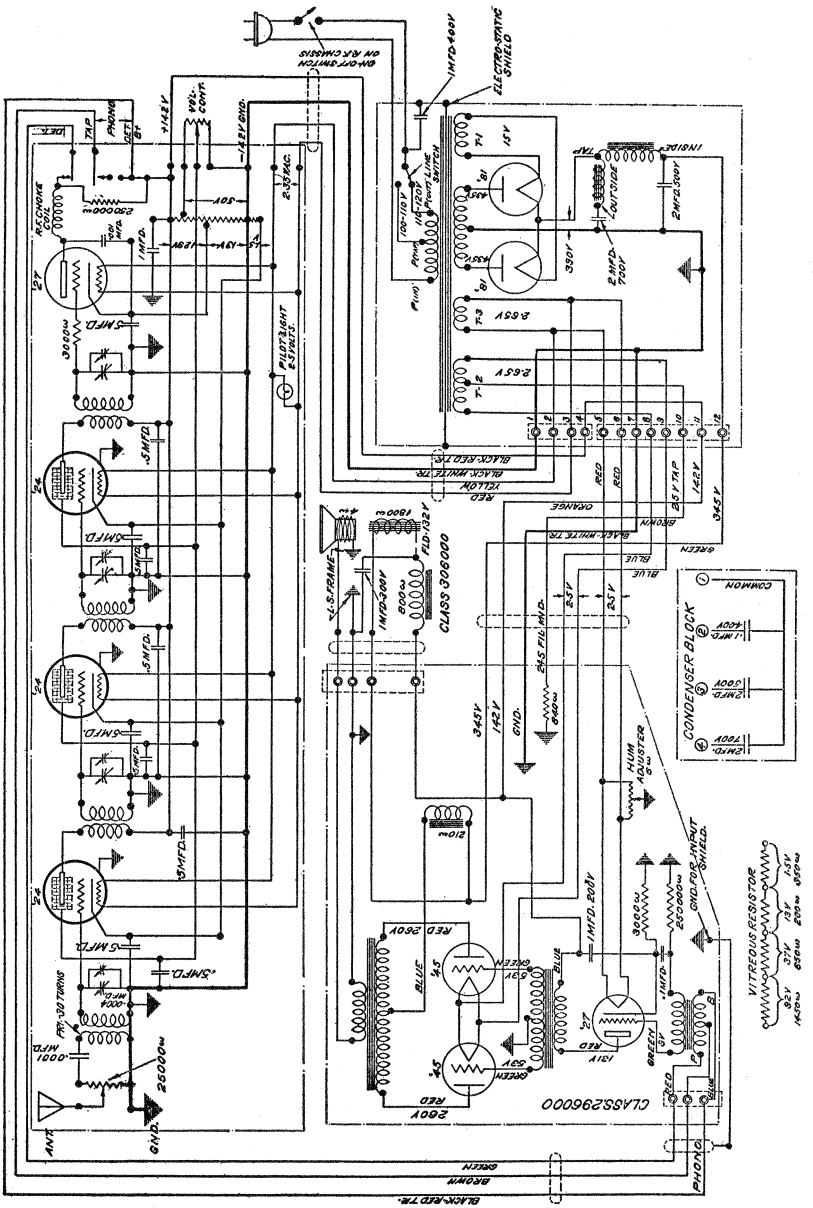
The secondary of the transformer then feeds directly into the first audio tube. In the grid return circuit a 250,000-ohm filter resistor is used between the transformer and ground. A .1-mfd. condenser provides the return path to the cathode. The cathode in turn is returned to the ground through a 3000-ohm resistor which biases the grid 6 volts negatively. The second audio stage is of the familiar push-pull arrangement employing two 245 tubes. The output transformer is mounted on the chassis itself and feeds into the voice coil of the dynamic speaker. A 6-ohm center-tapped resistor across the filament of the first audio tube serves as a hum adjuster.

The power supply unit is of standard design but has a number of special features incorporated in it. Two type 281 rectifying tubes are used with their filaments connected in series. These can furnish an ample supply of plate current without overloading the rectifying system. An elaborate filter system is used, which also contains a 120-cycle trap for eliminating any A.C. line hum. The input transformer is provided with an electrostatic shield which also helps to prevent any inductive hum interference. All parts of the circuit are clearly marked so that everything should be perfectly clear.

Average Tube Voltages — Line Pressure 112 Volts.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mills	Screen Volts
1st R.F.	224	2.2	130	1.5	1.2	45
2nd R.F.	224	2.2	130	1.5	1.3	45
3rd R.F.	224	2.2	130	1.5	1.1	45
Detector	227	2.2	120	10	1.5	—
1st A.F.	227	2.2	108	6	5.0	—
2nd A.F.	245	2.2	250	50	35	—
2nd A.F.	245	2.2	250	50	35	—
Rectifier	281	5.0	—	—	—	—
Rectifier	281	5.0	—	—	—	—

KOLSTER SCREEN GRID RECEIVER—MODEL K-44



ATWATER KENT SCREEN GRID RECEIVER--Model 55

The Atwater Kent Model 55 receiver is a 6-tube A.C. electric set employing two stages of tuned R.F. amplification with screen grid tubes of the 224 type, a power detector with a 227 type tube, a resistance coupled first audio stage with a 227 tube, and a push-pull second audio stage with tubes of the 245 type.

The tuning system consists of an antenna coupler and two R.F. transformers all tuned with a 3-gang condenser. Two aerial posts are provided, one for long and one for short aerials. If extreme selectivity is desired, a short aerial can be operated on the long aerial post. The receiver will not operate without a ground connection, nor will it operate when either antenna post is connected to the ground. The primary of the first R.F. transformer is tapped and a "Local-Distance" switch is provided so that the plate of the first tube can be connected either to the end or the tap on the coil. For local stations the tap is used, while for distant stations the full primary is cut in.

The cathodes of the two radio frequency tubes are biased negatively 3 volts through resistor R-5. The bypass condenser across R-5 has a capacity of 0.1 mfd. The two screen grid leads are connected together to the slider of the high resistance potentiometer R-3, which in turn is connected between the positive B supply and the ground. Resistor R-4 serves to reduce this pressure to 85 volts. The potentiometer R-3 also serves as a volume control, for when the slider is at the extreme right, the full 85 volts are impressed on the screen grid, and as the slider is moved to the left this pressure is reduced gradually to zero. This permits of perfect volume control, and at the same time cannot be the source of any disturbing noise, for being connected in a secondary circuit, it has nothing to do with the passage of the signal oscillations.

In the detector circuit, which uses a type 227 tube, plate rectification (power detection) is employed, the grid being biased negatively 12 volts by means of the 30,000-ohm cathode resistor R-7. In the plate circuit a high frequency filter is used consisting of a choke coil and two bypass condensers.

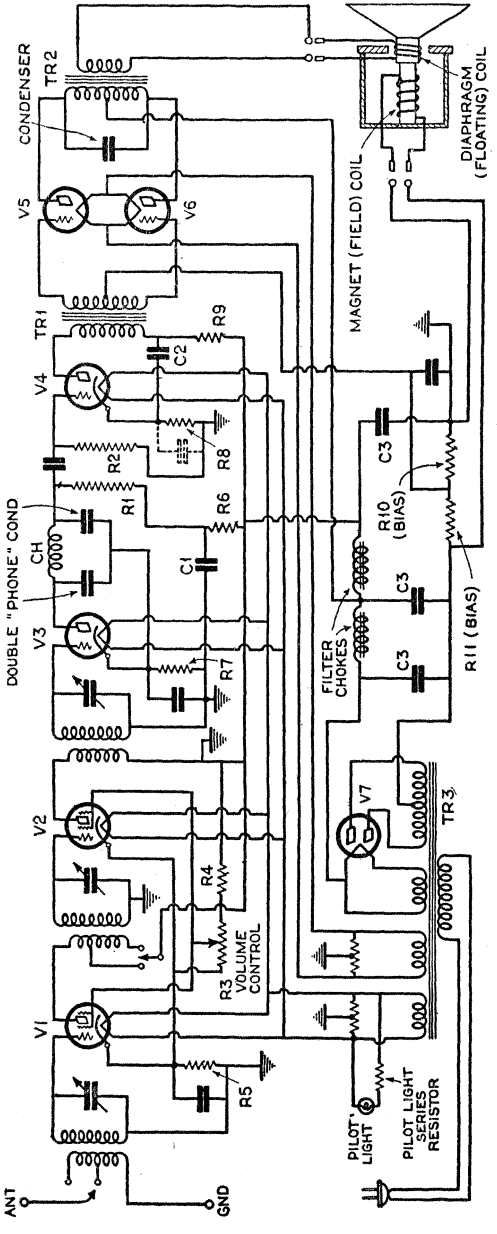
Resistance coupling is used in the first audio stage. A type 227 tube is used, with a plate pressure of 70 volts and a grid bias of 2 volts effected through the cathode resistor R-8. The output of the first audio stage is then supplied through a standard push-pull input transformer to a pair of 245 power tubes. These tubes use a plate pressure of 235 volts and a grid bias of 42 volts obtained through resistor R-10 connected into the negative B return line. A standard output transformer is used for coupling the tubes to the voice coil of a D.C. dynamic speaker.

In the following table is given a typical set of voltage readings.

Tube	Filament	Plate	Grid	Screen
1st Radio	2.4	175	3	85
2nd Radio	2.4	175	3	85
Detector	2.4	110	12	
1st Audio	2.4	70	2	
Power Tubes	2.4	235	42	
Rectifier	4.9			

The power supply is of standard design. The input transformer has four secondaries to provide the necessary A and B voltages, A full wave type 280 rectifier tube is used. This is followed by a filter system consisting of two choke coils and three filter condenser units.

ATWATER KENT SCREEN GRID RECEIVER - Model 55



THE ATWATER KENT MODELS 60 AND 60-C

The Atwater Kent Model 60 is a 7-tube A.C. screen grid receiver that has undergone numerous changes, and in its final form is as described here. The receiver employs three tuned R.F. stages with tubes of the 224 type, a power detector and first audio stage each with a type 227 tube, and a second audio with 245 tubes in push-pull.

The antenna coupler has a tapped primary for aerials of different lengths, and a tuned secondary which feeds directly into the grid of the first tube. The plate circuits of the first three tubes are supplied through R.F. chokes, Nos. 1, 2 and 3 in the circuit diagram. These chokes are very critical as to their position and nearness to other metallic objects. The first tube is coupled to the second through a fixed condenser and a potentiometer connected between a tap on the grid coil and the ground. This potentiometer serves as one section of a dual volume control in that it regulates the amount of energy supplied to the second tube. In the output circuit of this second tube is a "local-distance" switch which connects the tap on the second grid through the coupling condenser directly to the plate of the tube or to the high potential of the choke coil. The coupling between the third and fourth tubes is the same, except that no switch is used.

The cathode of the first tube is biased through a resistor which is in series with another resistor that biases only the second and third tubes. Connected in series with these is a bleeder resistance No. 2, a volume control resistor, and a tapped resistance No. 1. These last three resistors form a voltage divider that reduces the high output voltage to the proper values for the plate circuits of the three R.F. tubes, for the screen grid of the first tube and of the second and third tubes, and lastly for the cathode bias of the second and third tubes. The variable resistor comprises the other section of the dual volume control referred to above, and regulates the amount of current flowing through the bleeder resistors and the cathode to ground resistor. The resulting variable voltage drop across the latter is equivalent to changing the grid bias on the three R.F. tubes and hence also the amount of amplification. Suitable bypass condensers are used in the various cathode, plate and screen grid leads to reduce the high frequency resistance of the circuits and to prevent interstage coupling.

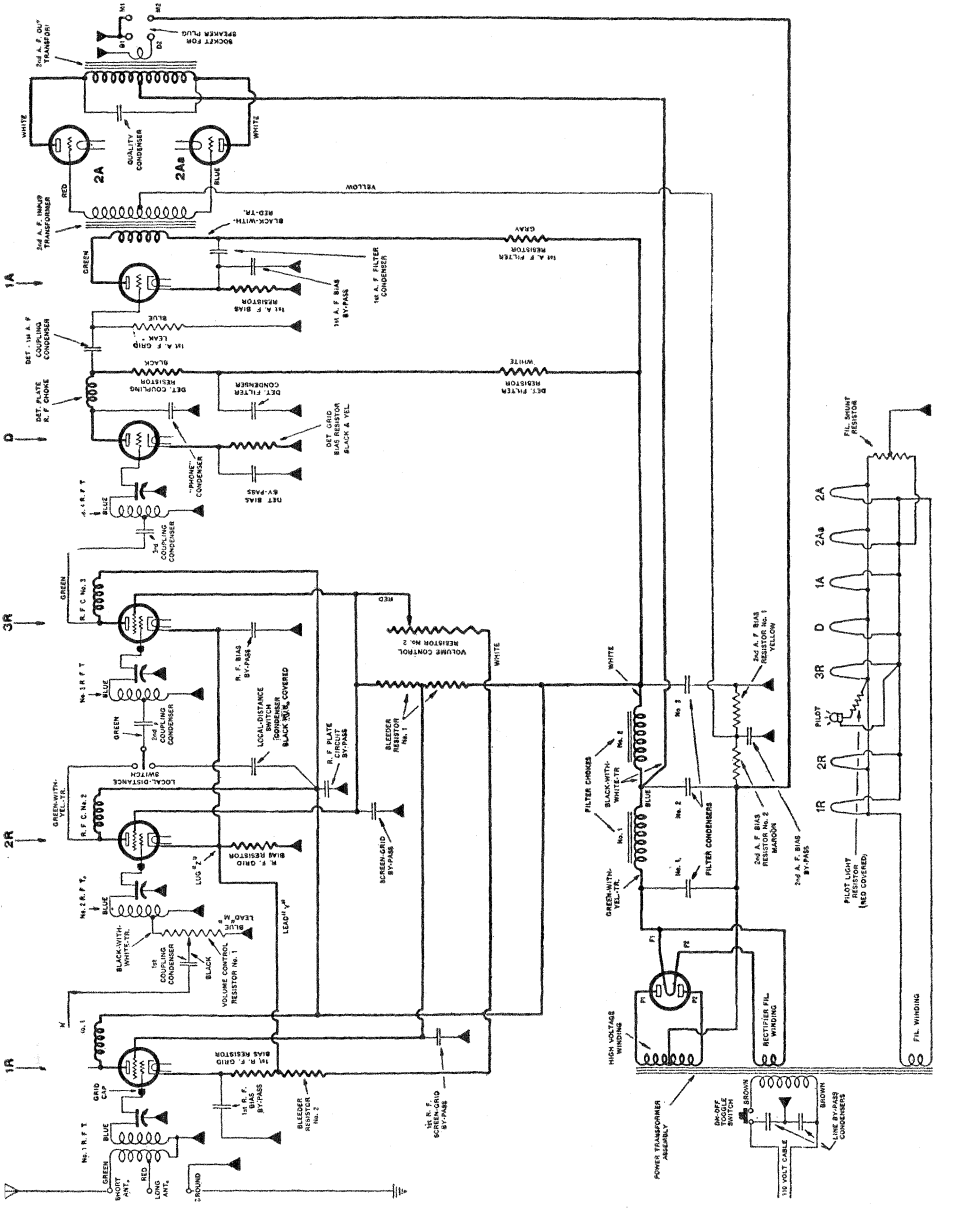
In the detector plate rectification is employed through the use of a cathode to ground bias resistor. An R.F. choke and bypass condenser are used in the plate circuit to keep the high frequency currents out of the first audio stage while a filter resistor and audio bypass condenser are also found further on in the plate lead to isolate the audio frequencies from the power supply.

The following socket voltages are obtained with a 120-volt line pressure.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias
1st R.F.	224	2.4	170	8
2nd and 3rd R.F.	224	2.4	175	4
Detector	227	2.4	110	12
1st Audio	227	2.4	75	2
2nd Audio	245	2.4	250	48

Resistance coupling is used in the first audio stage. The necessary grid bias for the 227 tube is obtained through a cathode to ground resistor. An audio frequency filter (resistor and bypass condenser) are also used in the plate circuit of this tube. A standard input transformer is used to couple this first stage to the second or push-pull stage in which two 245 power tubes are used. The output transformer is mounted on the chassis. A special socket is provided which takes a 4-prong plug, , by means of which the dynamic speaker can be connected or disconnected from the set.

ATWATER KENT SCREEN GRID RECEIVER - Model 60



THE AMRAD SCREEN GRID RECEIVER — MODEL 81

The Amrad Model 81 is an A.C. receiver that has a 3-stage R.F. amplifier using type 224 tubes, a detector using a type 227 tube, a first audio stage using a 227 tube, and a second audio stage using two 245's in push-pull.

The tuning system consists of a tapped antenna coupler and three R.F. transformers all tuned with a 4-gang condenser. A midget condenser connected across the first section and operated from a control knob on the panel, serves to adjust the antenna circuit to antennas of different lengths. The other three sections are provided with small balancing condensers so that they can be perfectly phased. The grid returns are brought directly to the ground, while the cathodes of the 224 tubes are connected together in series with a 31-ohm resistor R-2 to the ground. This resistor biases the control grids 1½ volts negatively. The screen grids are also connected together and in series with a 50,000-ohm variable resistor, which serves as a volume control by varying the screen potential from zero to 75 volts. In series with this variable resistor is a 21,000-ohm resistor for reducing the voltage.

In the detector grid rectification is employed through the use of a 1½-megohm grid leak and .00025-mfd. condenser. Distortion due to overloading is avoided, in that the high gain secured in the first audio stage causes the power tubes to overload at the same time as the detector would.

In the first audio stage a combination of resistance and impedance coupling is used. A 100,000-ohm coupling resistor R-6 is used in conjunction with the 12,500-ohm resistor R-16. In the grid circuit a tapped impedance of the autoformer type is used, and it is through the use of this coil that the voltage step-up is obtained. The blocking condenser C-9 has a capacity of .5 mfd. The double-pole phonograph switch S-3 is arranged so that when one side is closed the other is opened. Hence, when the phonograph is connected into the circuit, the detector and R.F. amplifier are disconnected. The grid bias for the first audio tube is secured through the 2500-ohm resistor R-4. The condenser C-4 has a capacity of 1 mfd. The grid bias for the 245 tubes is obtained by means of the 1860-ohm resistor R-12. The output of these tubes is supplied to the voice coil of the dynamic speaker through a suitable output transformer.

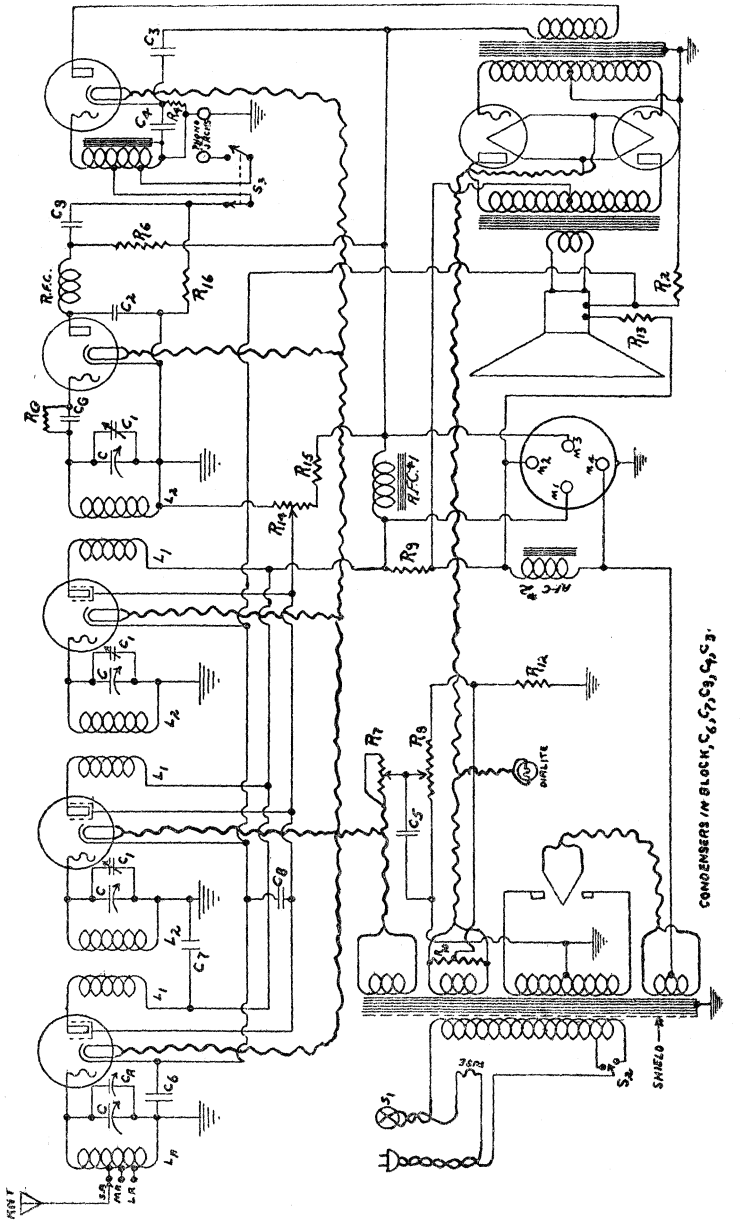
Average tube voltages with a 120-volt line pressure.

Position	Tube	Fil. Volts	Plate Volts	Plate Mills	Grid Bias	Screen Volts
1st, 2nd and 3rd R.F.	224	2.25	180	4	1.5	80
Detector	227	2.25	30	1.5	—	—
1st Audio	227	2.25	160	4	10.5	—
Power Tubes	245	2.25	250	28	5	—
Rectifier	280	4.65	—	108	—	—

The power supply system is of standard design, using a power transformer with the necessary high and low voltage windings, a low and high impedance filter choke, and a Mershon filter condenser having two 8-mfd., and two 18-mfd. sections.

A.C. hum elimination is also secured through the use of the 200,000-ohm potentiometer R-8, the slider of which is connected to the moving contact of the tapped filament resistors R-7. The latter adjusts the midpoint on the heater circuit and the former (R-8), controls the amount of positive potential applied to the heater with respect to the cathode, which is at ground potential. In the latter models the potentiometer R-8 is omitted and the tap from R-7 is connected to a sliding contact across R-12. Condenser C-5 has a capacity of .25 mfd. In the speaker circuit resistor R-13 of 1500 ohms serves to reduce the field current to the required value of 30 milliamperes. The field resistance itself is 7000 ohms.

AMRAD SCREEN GRID RECEIVER—MODEL 81



THE STROMBERG-CARLSON MODELS 641 AND 642

The Stromberg-Carlson Models 641 and 642 both employ the same chassis, but the former is in a table model and the latter in a console type cabinet. The circuit arrangement consists of three stages of tuned R.F. amplification with type 224 tubes, a grid-bias detector with a type 227 tube, and a stage of audio amplification employing a single type 245 power tube.

The tuning system consists of an antenna coupler and three R.F. transformers, all tuned by means of a 4-gang condenser. Each condenser section is provided with a trimmer so that all circuits can be perfectly aligned. The primary of the antenna coupler is of the high impedance type and consists of many turns of fine wire wound in a slotted disk. It is loosely coupled to the secondary. With this construction the length of the antenna does not affect the secondary, and hence no separate antenna trimmer is needed. The winding is also shunted by a 20,000-ohm potentiometer, which serves as an input volume control. The coils and condenser sections are all individually shielded. The three 224 tubes are connected into the circuit in standard form. In the case of the first two tubes the cathodes are brought to the slider on an 800-ohm variable resistor which serves as a volume control by varying the grid bias. The 170-ohm fixed resistor serves as a stop to limit the minimum bias. With the third tube only a 390-ohm fixed resistor is used for biasing the cathode. A .3-mfd. condenser is used to bypass to ground the cathode, plate and screen grid of each R.F. tube. These condensers are mounted four in a metal case, the cases at the same time serving as shields between the sockets. In the third case three of these condensers are connected in parallel and form a .9-mfd. bypass for the detector cathode.

The volume control is double-acting and functions to control both the voltage supplied from the antenna and the amplification gain in the R.F. amplifier. It is in the form of two potentiometers operated from one knob, but arranged so that the signal is first reduced greatly by the antenna input control before the biases of the first two amplifier tubes are changed. In this way distortion is prevented due to the overloading of the first radio frequency tube.

In the power detector a plate pressure of 250 volts is employed and a grid bias of 28 volts obtained through a 15,000-ohm biasing resistor. An R.F. filter is used in the plate circuit consisting of a 10-millihenry choke shunted by two .0005-mfd. bypass condensers. The detector circuit also has a 2-megohm grid leak and a .00025-mfd. condenser, but these have nothing to do with the detector action of the tube. They serve merely to isolate the phonograph pick-up from the R.F. system and also as a scratch filter for the pick-up. An external transformer is used to couple the pick-up to the detector tube, and the latter then acts as a first audio stage. The pick-up is connected into the circuit by turning the volume control knob clear to the left.

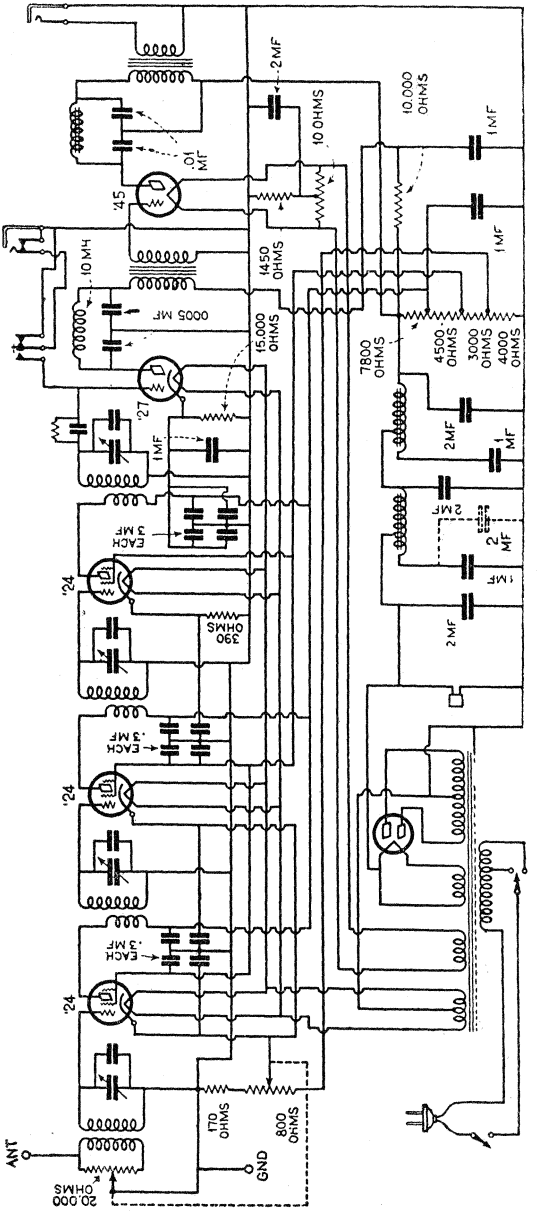
In the audio stage transformer coupling is used to feed into a single 245 tube. An output transformer is also used to couple the tube to the loudspeaker. In the plate circuit of the 245 tube an audio filter is used to prevent undesirable noises from reaching the speaker and to cut off the higher audible frequencies. A 1450-ohm resistor is used to obtain the necessary grid bias.

Average socket voltages with 114 volt line pressure.

Position	Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's.	Screen Volts
1st, 2nd and 3rd R.F.	224	2.24	136	3.5	1.5	55
Detector	227	2.24	248	3.	1.8	—
Audio —	245	2.24	238	35.	30	—

The B-power supply is of standard design, except that the filter

STROMBERG-CARLSON—MODELS 641 and 642



EDISON LIGHT-O-MATIC RADIO—Models R-4 & R-5

The Edison radio receivers, Models R-4, R-5 and C-4, are 7-tube sets employing three stages of tuned, neutralized R.F. amplification, a tuned input detector, a transformer coupled first audio stage, and a push-pull second stage feeding a D.C. dynamic speaker. Type 227 tubes are used throughout, except in the output stages where two type 245 tubes are used.

The R.F. amplifier gives uniform amplification over the entire wave length band, due to the use of a double primary on each coil, one section being resonated above the broadcast range and the other below. All secondaries are tuned with a 4-gang condenser which is equipped with individual trimmers for each stator section. Oscillations are suppressed by neutralizing the grid circuits with suitable neutralizing condensers.

The cathode of the first tube is biased by resistor R-1 (1000 ohms) bypassed by condenser C-20 (.1 mfd). Resistor R-2 (1000 ohms) in connection with condenser C-20 (.1 mfd) forms a filter to isolate the R.F. components of the plate current. Resistor R-3 (400 ohms) bypassed by condenser C-23 (1 mfd) biases the cathodes of the 2nd and 3rd R.F. tubes, while resistor R-5 (400 ohms) and condenser C-22 (.1 mfd) form a filter for the R.F. components of the plate current.

A double volume control is employed, labeled resistors A and B in the circuit diagram. Resistor A regulates the amount of energy supplied from the antenna to the first R.F. transformer, while resistor B varies the grid bias of the 2nd and 3rd radio frequency tubes. When the volume control is turned to minimum, a further slight turn throws the radio-phono switch S-1 to phonograph operation.

In the detector grid leak detection is employed, and in the plate circuit an R.F. choke L-13 is used to keep the high frequency currents out of the audio system, while condenser C-14 (.001 mfd) offers these currents an easy return to the cathode.

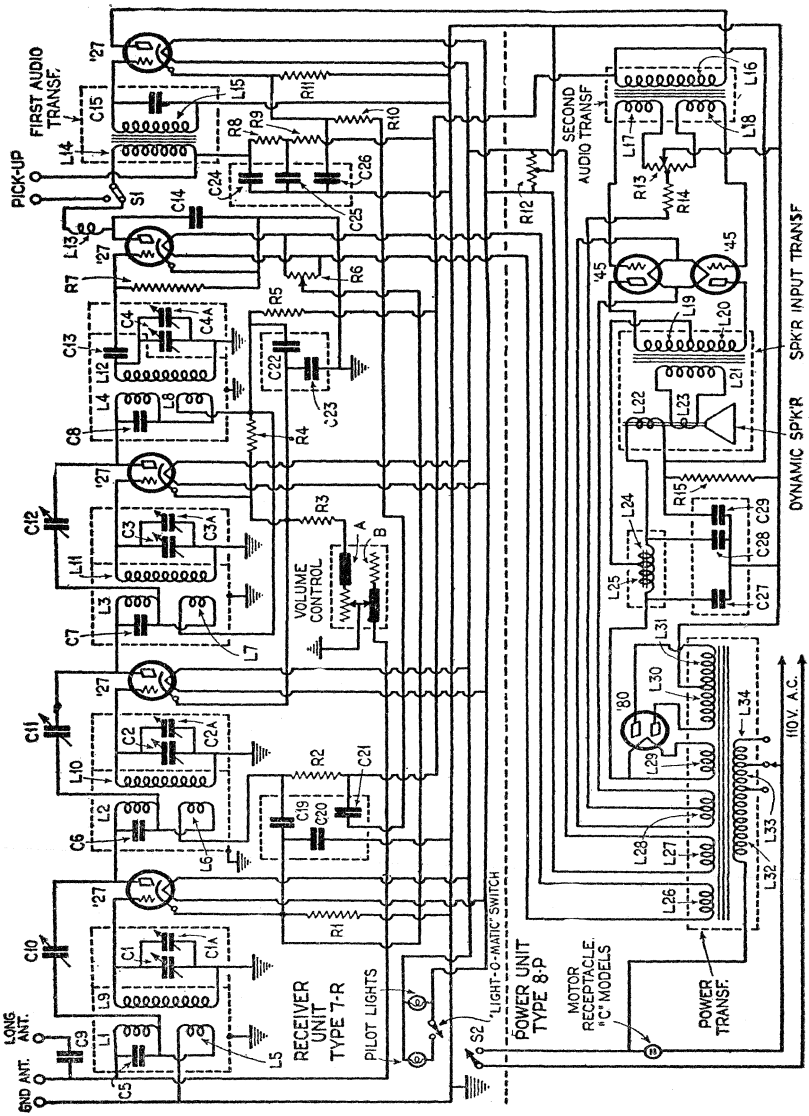
A triple-purpose filter composed of R-8 25,000 ohms, R-9 25,000 ohms, C-24 1 mfd. and C-25 .5 mfd, is also used in the detector plate circuit. It reduces the plate pressure to the required value, reduces the A.C. ripple in the plate current, and isolates the audio frequency oscillations and prevents them from getting into the power supply. R-6 is a 20-ohm center-tapped resistor serving as a hum adjuster.

In the first audio stage, the transformer secondary is shunted by a .00045 mfd bypass condenser which serves as a high frequency cut-off. Resistor R-11 (2000 ohms) is a cathode bias resistor shunted by a 1-mfd condenser C-26. The series circuit R-10-C-21 serves to eliminate the 120-cycle hum in the plate supply of the first audio tube. R-10 has a resistance of 6000 ohms and C-21 a capacity of 0.16 mfd.

The push-pull input transformer has two separate half secondaries with the center-tapped 200-ohm resistor connected between the low potential ends to balance perfectly both sides of the amplifier and to remove any hum. The output transformer feeds directly into the voice coil of the speaker.

In the power supply the transformer has three primary taps to meet different line voltage requirements, and five secondary windings to provide the necessary A and B voltages. The 20-ohm center tapped resistor R-12 serves to ground the electrical center of the R.F. and A.F. heater circuit. A 280 rectifying tube is used. In the filter circuit a tapped choke coil is used, with the plate supply for the two 245's taken off at the tap. The choke is bypassed by two 600-volt 2-mfd filter condensers C-27 and C-28. The field of the speaker L-22 (4500 ohms) serves as a second filter choke and is shunted by the condenser C-29 (1 mfd. 300 volt). Resistor R-15 (10,000 ohms) serves as a bleeder resistor to provide the required current for exciting the speaker field and to stabilize the plate voltage.

EDISON LIGHT-O-MATIC—MODELS R-4 and R-5



THE VICTOR MODELS R-32, R-52 AND RE-45

The Victor Micro-Synchronous radio receiver is a power operated A.C. set employing an antenna coupling stage and four stages of tuned radio frequency amplification, all with tubes of the 226 type. The detector is of the grid leak type and uses a type 227 tube. Transformer coupling is used in the audio stages with a type 226 tube in the first stage and two type 245 tubes in push-pull in the second stage.

A high degree of sensitivity is obtained by means of a system of micrometer adjustments on the tuning condensers, permitting precision automatic alignment or synchronization of the tuned R.F. stages at all times over the entire tuning range. The instrument is built up of three units: 1—the tuning unit which contains the radio frequency stages and detector, 2—the power amplifier which contains the first and second audio stages and the rectifier, and 3—the reproducer.

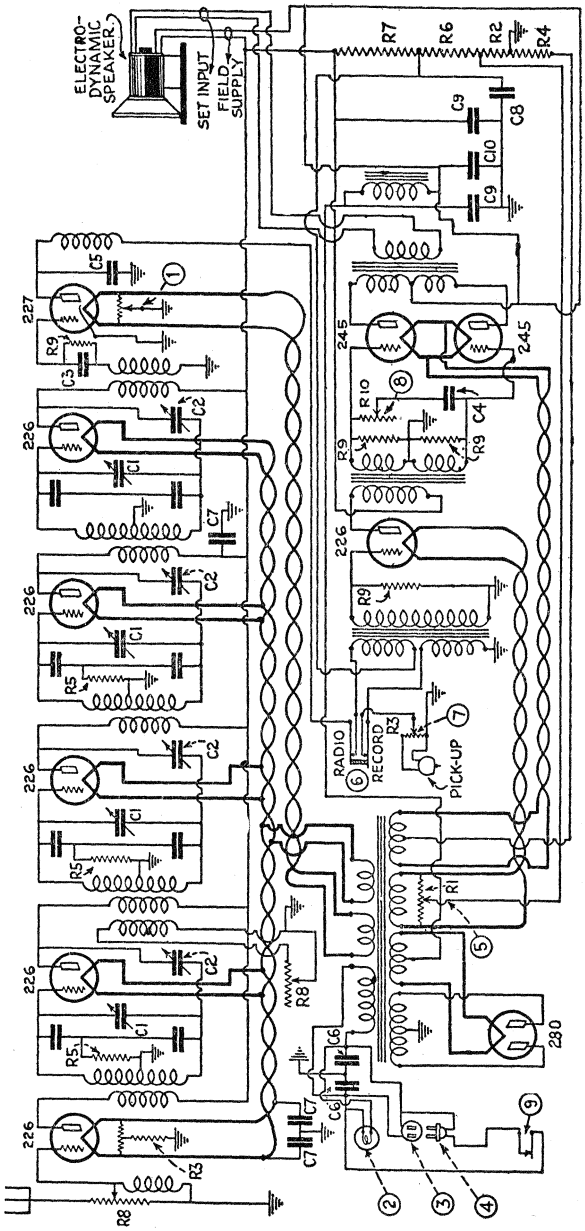
The circuit is of practically standard design throughout, but also has a number of special features incorporated in it. A dual volume control operated by a single knob is employed, one section consisting of a 3800-ohm resistor R-8 across the antenna coil, and the other a similar resistance connected across a special coil which serves as an absorption circuit. Resistors R-5 (800-ohms each) serve to render the tuning more uniform over the entire range. The first audio transformer has two primaries, one of which receives the output of the detector tube and the other the output of the phonograph pick-up. A 5-megohm resistor is connected across the secondary in order to eliminate any amplification peaks and to assist in bringing out the lower tones. The secondary of the push-pull input transformer also has a 5-megohm resistor across each section. In addition, there is a tone control across the winding, which consists of a 1-megohm variable resistor in series with a .002-mfd. condenser. The output transformer feeds directly into the voice coil of the dynamic speaker. A 20-ohm center-tapped resistor with the tap grounded, is connected across the filament of the first audio tube, another across the filament of the detector tube, and a third across the R.F. filament circuit. Each of these serves as a hum control. A filter consisting of two .1-mfd condensers connected in series is connected across the A.C. power input. The bypass condenser in the detector plate circuit has a .001-mfd. capacity. A filter consisting of two .25-mfd. condensers in series also is connected across the filament of the R.F. tubes. The filter condensers C-8 has 5-mfds., C-9 has 2.5 mfds., C-10 has 3 mfds., and C-11 has .125 mfd. The R.F. biasing resistor R-3 is 200-ohms. A 5-megohm grid leak R-9 is used.

Average tube voltages with 110-volt line pressure.

Position	Type	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's
1st R.F.	226	1.3	105	9	3.9
2nd R.F.	226	1.3	105	9	3.9
3rd R.F.	226	1.3	105	9	3.9
4th R.F.	226	1.3	105	9	3.9
5th R.F.	226	1.3	105	9	3.9
Detector	227	2.1	40	—	3.0
1st Audio	226	1.3	100	6	4.5
2nd Audio	245	2.1	230	40	37
Rectifier	280	4.4	—	—	57

For best average sensitivity and selectivity the antenna should be from 50 to 75 feet long including the lead-in and ground wires, except for local reception when a five or six foot wire will serve satisfactorily. A good ground connection is highly important and must be used at all times. A spark may occur if the ground is connected while the power plug is in the receptacle due to the condenser discharge from the power line, but this can cause no harm.

VICTOR—MODELS R-32, R-52 and RE-45



THE ERLA A.C. SCREEN GRID RECEIVER—Model 224

The Erla Model 224 receiver is a 7-tube all-electric set and comprises three stages of tuned radio frequency amplification with four tuned circuits using the 224 screen grid tubes. The detector is a 227 tube operated as a grid bias or power detector. In the first audio stage a 227 tube is used in resistance coupling. Following this are two type 245 tubes in a push-pull output stage.

Reference to the circuit will show that two antenna terminals are provided, one for long and the other for short aerials. The short aerial post should preferably be used as it will give greater sensitivity and selectivity. But if the antenna is very long, the long antenna post should be used, for the attenuating resistor in series with this post will then reduce the back-ground noise. The three R.F. stages as well as the detector are tuned with a 4-gang condenser, and each R.F. stage is individually shielded. The first R.F. transformer is tapped and connections are brought out to a "local-distance" switch on the panel. When thrown to the local position, the tap is used and less amplification is had, while in the distance position full benefit is had of the transformer and maximum sensitivity is obtained. On nearby powerful stations the 224 tubes may overload, and therefore, whenever possible the switch should be kept in the local position.

Volume is controlled by means of a 6000-ohm wire wound resistor connected so as to vary the voltage applied to the screen grids and in this manner control the amplification of the tubes. In combination with this volume control is a single-pole double-throw toggle switch which operates to throw the receiver from "phonograph" to "Radio" or vice versa. When the control is turned all the way to the left, the circuit of the input to the first audio stage is switched from the output of the detector circuit to the phonograph pick-up jacks at the rear of the chassis.

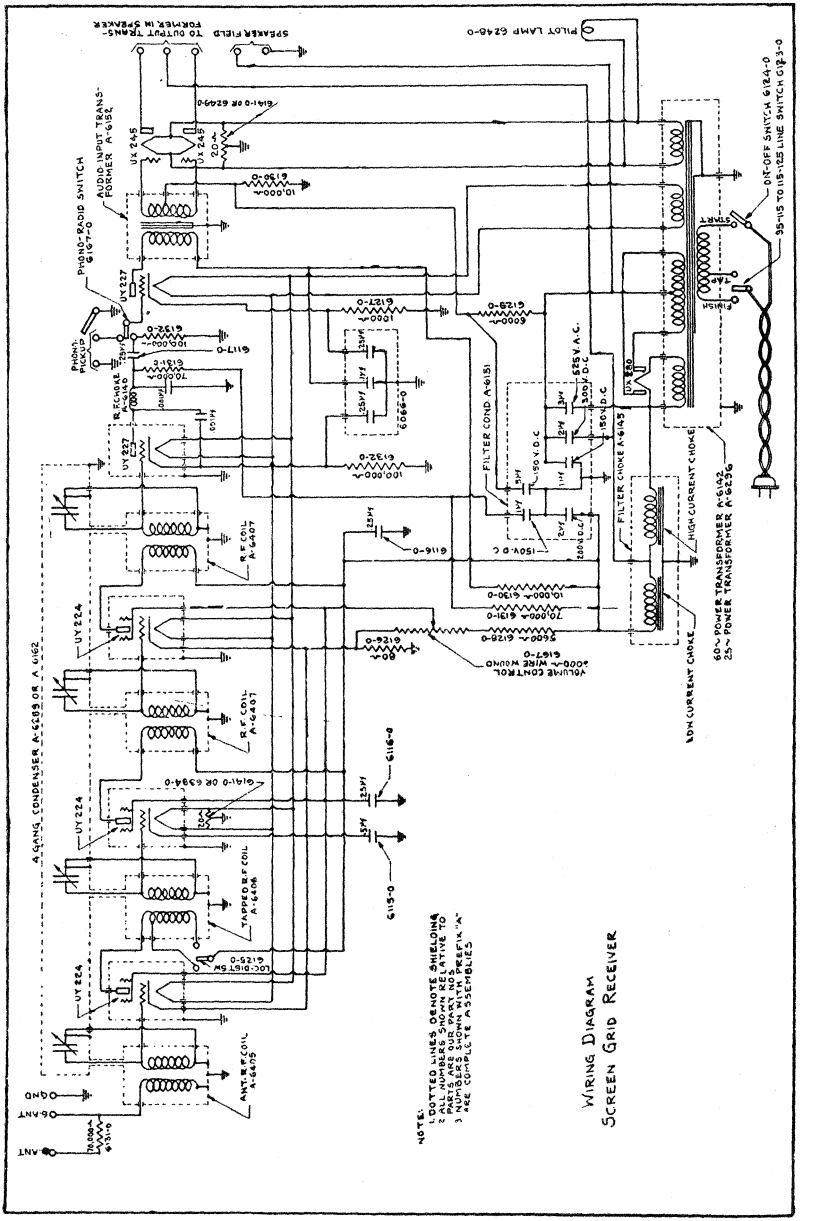
The power supply unit consists of a power transformer that provides the necessary A and B voltages, a low current and high current choke, a filter condenser block, a full-wave type 280 rectifier, and a voltage dividing resistor. A switch is provided in the primary circuit of the power transformer for different line voltages, one position for 95-115 volts and the other for 115-125 volts.

The dynamic speaker used here is somewhat different from the average practice. The field has a D.C. resistance of 1000-ohms and is designed to carry 100 milliamperes. Examination of the circuit shows that the field is connected into the negative return line of the B power supply, and the entire plate current thus flows through the field. This offers the advantage of providing additional filtering inductance. All connections from the speaker are made by means of a 5-conductor cable and a special plug which fits into the speaker receptacle only one way.

In the following table is given a series of average voltages on the various tubes. Variations in tubes and in resistor values will cause slight variations from the values given. Readings are taken with the volume control full on.

	Tube	Filament	Plate	Cathode	Screen
R.F	224's	2.35 to 2.4	160 to 170	1.5 to 2	75 to 80
Audio	227	2.35 to 2.4	90 to 100	4.5	—
Det.	227	2.35 to 2.4	60 to 75	6 to 7.5	—
Power	245's	2.4 to 2.5	240 to 250	—	—
Rect.	280	4.8 to 5	340 to 360	—	—

ERLA SCREEN GRID RECEIVER—MODEL 224



BRANDES MODELS B-15 AND B-16

The Brandes Models B-15 and B-16 are 7-tube A.C. electric receivers employing three stages of tuned radio frequency amplification with heater type tubes of the 227 type, a detector and transformer coupled first audio stage each with a type 227 tube, and a second audio output stage with two type 171A tubes in push-pull in the earlier models or two type 245 tubes in the later models.

The tuning system consists of an antenna coupler and three R. F. transformers all tuned with a 4-gang condenser. Across the primary of the antenna coupler is a 25,000-ohm variable resistor which serves as an input volume control. Oscillations in the R.F. amplifier are suppressed with 2700-ohm resistors connected into the grid circuits of the first three tubes. Grid rectification is used in the detector circuit with a 2-megohm grid leak and a .0002-mfd. condenser.

The detector output is fed to the first audio tube through a standard transformer. The grid of this tube is biased with a 1600-ohm resistor connected between the cathode and ground. A standard input transformer is used into the push-pull stage, while the output transformer is built into and forms part of the dynamic speaker. Phonograph pick-up jacks are also provided, these being connected directly across the primary of the first audio transformer. The values of all resistors and bypass condensers are clearly indicated in the accompanying circuit diagram.

The power supply is built up as a separate unit and consists of an input transformer, rectifier, filter system, and the necessary voltage dividing resistors. An interesting feature is the filter choke used which has a primary and secondary winding. These windings have a bucking effect which results in a more perfect filtering action and the elimination of practically all A.C. hum. The dynamic speaker field serves as a second filter choke.

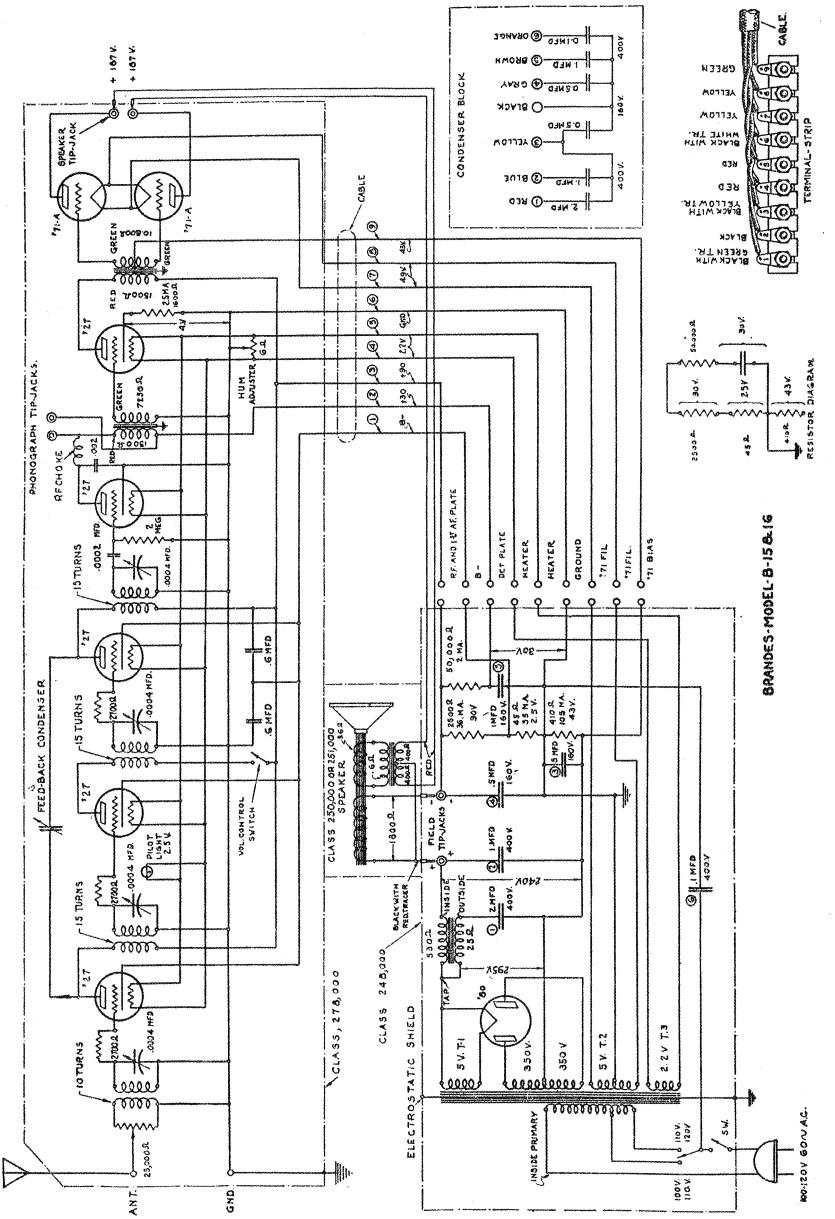
In the earlier models of these receivers type 171A tubes were used in the output stage, but later on these were replaced with type 245 tubes. This change was accomplished by connecting a suitable resistance in series with each side of the filament leads coming from the power transformer in order to reduce the filament pressure from 5 to 2½-volts as required for the 245 tubes. Of course, in taking voltage readings the leads will show 5 volts at the transformer terminals but only 2½ at the tube sockets when the tubes are turned on. The plate and grid bias voltages remain the same as given in the table below, no changes being made in any of the biasing resistors. In still later models a different type transformer was used with a tapped filament winding so that either two 171-A or two type 245 power tubes could be used.

TUBE VOLTAGES AT 112-VOLT LINE PRESSURE

Position of tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st, 2nd & 3rd R. F.	227	2.2	88	2.5	5.6
Detector	227	2.2	24	0	1.2
1st Audio	227	2.2	85	4.5	4.0
2nd Audio	245	2.3	190	36	20

A prominent hum may be due to a grounded or improperly adjusted hum control, a defective rectifier or detector tube, shorted grounding condenser, punctured filter or bypass condenser, improperly grounded A.C. line, or a poor contact on the terminal card. Oscillations may be caused by excessive plate voltage on the R. F. tubes, too long an antenna, feed-back condenser out of adjustment, defective ground connection, shorted R. F. choke coil, or open 0.6 bypass condenser.

BRANDES MODELS B-15 AND B-16



BREMER-TULLY — MODELS 6-40 AND 6-41

The Bremer-Tully models 6-40 and 6-41 are 6-tube A.C. electric receivers that employ type 226 tubes in the R.F. and first audio stages, a 227 tube in the detector, and a type 171-A tube in the second audio or output stage. The antenna coupler consists of a 100,000-ohm fixed resistor shunted by a .00004 fixed condenser. A .00025 series condenser is also employed. Two stages of tuned R.F. amplification are used followed by a tuned detector. Volume is controlled by means of a 10,000-ohm variable resistor connected across part of the secondary of the second R.F. transformer. A .006 condenser is shunted from the detector plate to the cathode. The detector is coupled to the first audio stage through an audio transformer. This transformer as well as the second audio and output transformer are all mounted in a single can together with three by-pass condensers.

The power converter is built as a separate unit and is connected to the receiver itself through a color-coded cable. A type 280 full wave rectifier is used. The filter system consists of two chokes and a 3 section condenser of 1, 2 and 2 mfds. The dynamic speaker field is connected in parallel with the second choke. All voltage divider and biasing resistor values are given in the circuit diagram.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position	Tube Type	Fil. Volts	Plate Volts	Grid Volts	Plate Mills
Ant. Coupler	226	1.4	150	9	7
1st and 2nd R.F.	226	1.4	150	9	8
Detector	227	2.2	60	0	3
1st Audio	226	1.4	140	9	7-8
2nd Audio	171-A	4.9	150	30	18

BREMER-TULLY — MODELS 7-70 AND 7-71

Models 7-70 and 7-71 are 7-tube A.C. electric receivers with three tuned R.F. stages employing type 226 tubes, a detector and transformer coupled first audio stage each with a type 227 tube, and an output stage with two 171-A tubes in push-pull. The R.F. amplifier utilizes the "Counterphase" neutralizing system. A 4-section tuning condenser is used, with a trimmer across the fourth section and another across the first section operated from the front panel as a sensitivity control. Volume is controlled with a 10,000-ohm potentiometer connected between the antenna and grid return of the second R.F. transformer and the ground.

A phonograph jack is connected across a section of the primary of the first audio transformer so that the proper impedance is provided for the pick-up. The tone control functions by shunting the secondary of the first audio transformer with a .003 condenser and the primary of the second transformer with a .01 condenser. Normally a .00025 condenser is shunted across the first transformer secondary. A similar capacity is shunted across one section of the primary of the second transformer to prevent oscillation in the push-pull circuit due to variations in tubes.

The power converter is built up as a separate unit and is of standard design and construction. A magnetic or separately excited dynamic speaker can be used with the wire jumper across A and B, or the speaker field can be excited by connecting it across A and B and placing the jumper across A and C.

TUBE VOLTAGES AT 115-VOLT LINE PRESSURE

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills.
1st, 2nd and 3rd R.F.	226	1.4	150	9	5
Detector	227	2.1	60	0	2
1st Audio	227	2.1	150	8	5
2nd Audio	171-A	4.9	150	30	18

BREMER-TULLY MODELS 6-40 AND 6-41

B-T 6-40 Circuit Diagram

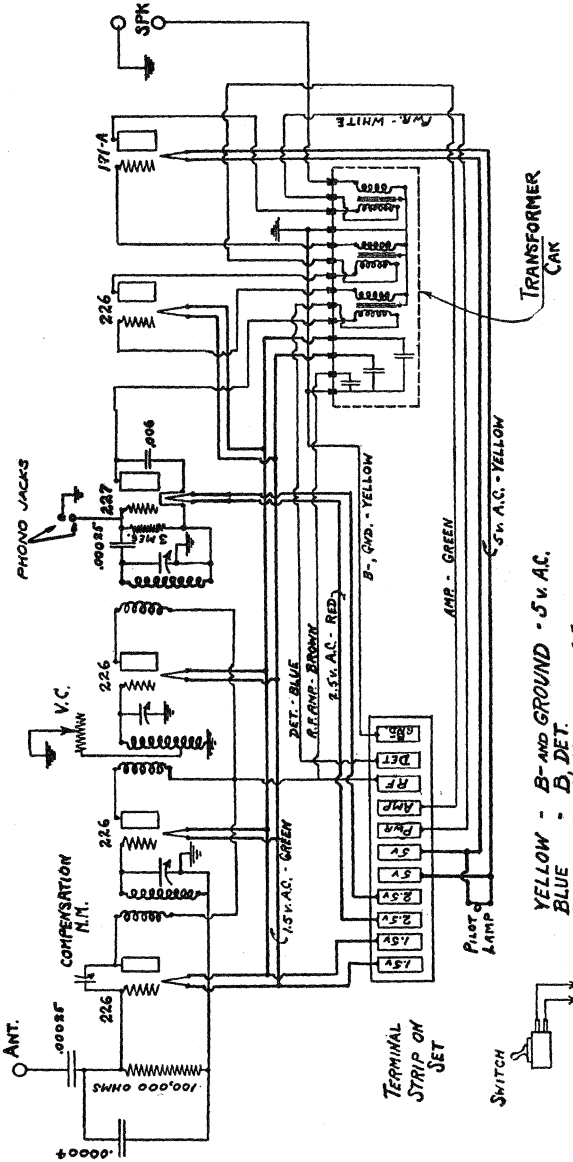
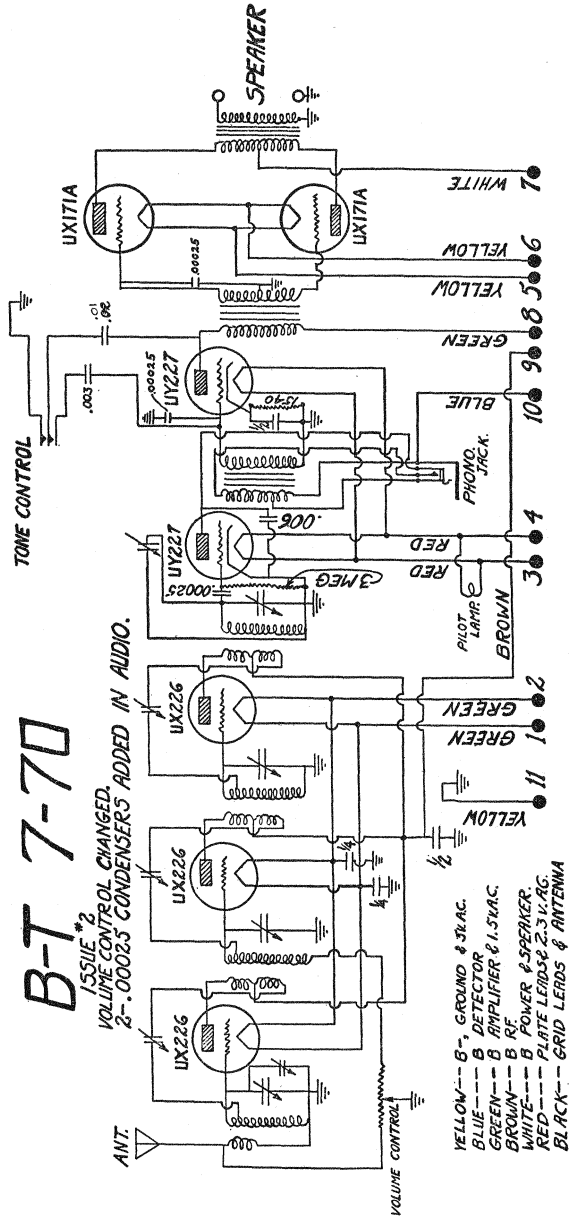


Diagram 6-A

BREMER-TULLY MODELS 7-70 AND 7-71



POWER CONVERTERS MODELS 6-40 AND 7-70

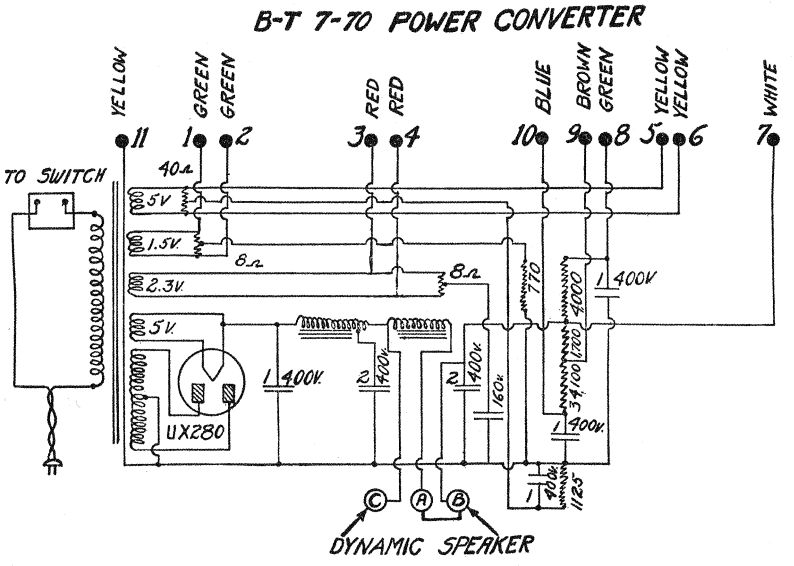
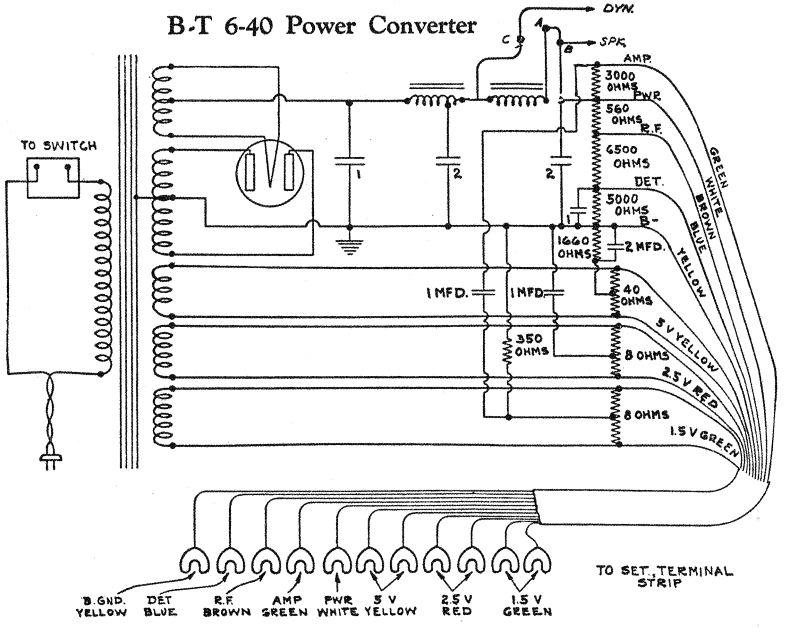


Diagram 7-B



BREMER-TULLY — MODELS 8-20A AND 8-21A

The models 8-20A and 8-21A are 8-tube A.C. electric receivers employing four tuned R.F. stages with type 226 tubes, a detector and transformer coupled first audio stage with type 227 tubes, and an output stage having two type 210 tubes in parallel with a speaker output transformer.

The tuning system consists of an antenna rejector circuit and four R.F. transformers all tuned with a 5-gang condenser. The R.F. amplifier utilizes the "Counterphase" neutralizing system. Volume is controlled with a 10,000-ohm potentiometer connected between the antenna and B terminal of the second R.F. transformer (a .006 condenser in series) and the ground. Across each of the R.F. tube filaments is a filter consisting of two .25 mfd. condensers in series with the midpoint grounded. Each R.F. plate lead contains a choke coil to keep the high frequency currents out of the power unit, while bypass condensers of 0.1 mfd. conduct them to the ground.

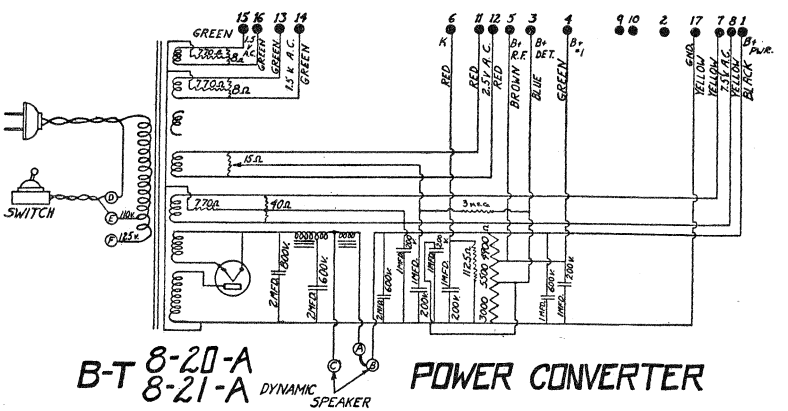
A phonograph pick-up jack is connected into the plate circuit of the detector tube so that the transformer primary is connected either into the detector circuit or across the phonograph pick-up. The grid of the first audio tube is biased by means of an 1125-ohm cathode resistor which in turn is by-passed by a 1-mfd. condenser. The second audio or output stage contains two type 210 tubes connected in parallel. The grids of these tubes are biased negatively by means of a 770-ohm resistor connected between the ground and a 40-ohm center-tapped filament resistor.

The power supply is built up as a separate unit and contains the input transformer, a type 281 half-wave rectifier, the filter chokes and condenser, the voltage dividing resistors, and all the grid biasing resistors and the necessary bypass condensers. All the resistors and condenser values are given in the circuit diagram.

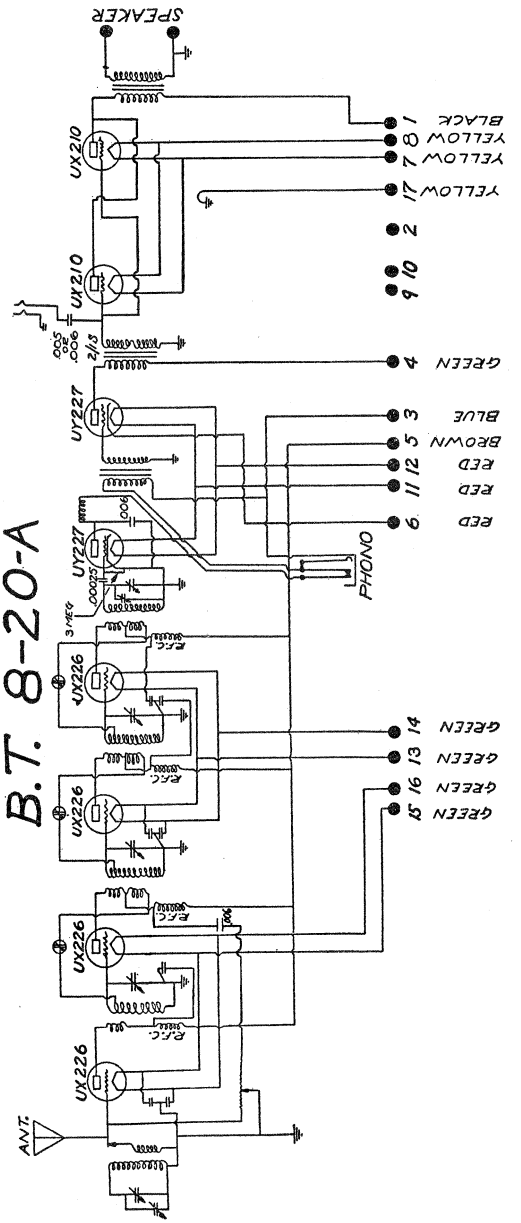
TUBE VOLTAGES AT 115-VOLT LINE PRESSURE

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's
Ant. Coupler	226	1.4	150	10	5
1st, 2nd and 3rd R.F.	226	1.4	150	10	5
Detector	227	2.2	60	0	2
1st Audio	227	2.2	130	7	5
2nd Audio	210	7.5	350	18	20

CIRCUIT DIAGRAM OF POWER CONVERTER



BREMER-TULLY MODELS 8-20 AND 821A



BREMER-TULLY — MODELS 81 AND 82

The Bremer-Tully Models 81 and 82 are 7-tube A.C. electric receivers employing three stages of tuned radio frequency amplification with tubes of the 227 type, a detector using grid rectification and employing a 227 tube, a transformer coupled first audio stage with a 227 tube, and a second audio or output stage with two type 245 tubes in push-pull. The receiver is built up in three units: the R.F. chassis, the amplifier and power unit, and the electrodynamic speaker. The R.F. chassis and power unit are in turn mounted on a single board and can easily be moved into or out of the console cabinet.

The tuning system consists of an antenna coupler and three R.F. transformers, all four individually shielded and tuned with a 4-gang condenser. A trimmer or antenna compensator is provided across the first condenser section and is operated from a knob on the front panel. The three R.F. stages are neutralized in the familiar neutrodyne system. Volume is controlled with a 25,000-ohm variable resistor connected into the cathode circuit of the three R.F. tubes with an 800-ohm fixed resistor to prevent the bias from dropping below the required minimum. The volume control also operates the "on and off" switch for the A.C. supply to the set. All grid and plate circuits are liberally bypassed, the capacity of all condensers being clearly indicated in the circuit diagram.

The detector output is coupled to the first audio tube through a standard transformer. A phonograph jack is also connected into the detector plate circuit. The transformer secondary is shunted by a .2-megohm resistor to smooth out any voltage peaks. The grid of the first audio tube is biased negatively through a 3500-ohm cathode resistor. A 100,000-ohm filter resistor is also used in the grid circuit of this tube for better tone quality. A .25-mfd. condenser then bypasses the grid circuit to the cathode. An input transformer finally couples the first audio to the output stage in which two type 245 tubes are used in push-pull.

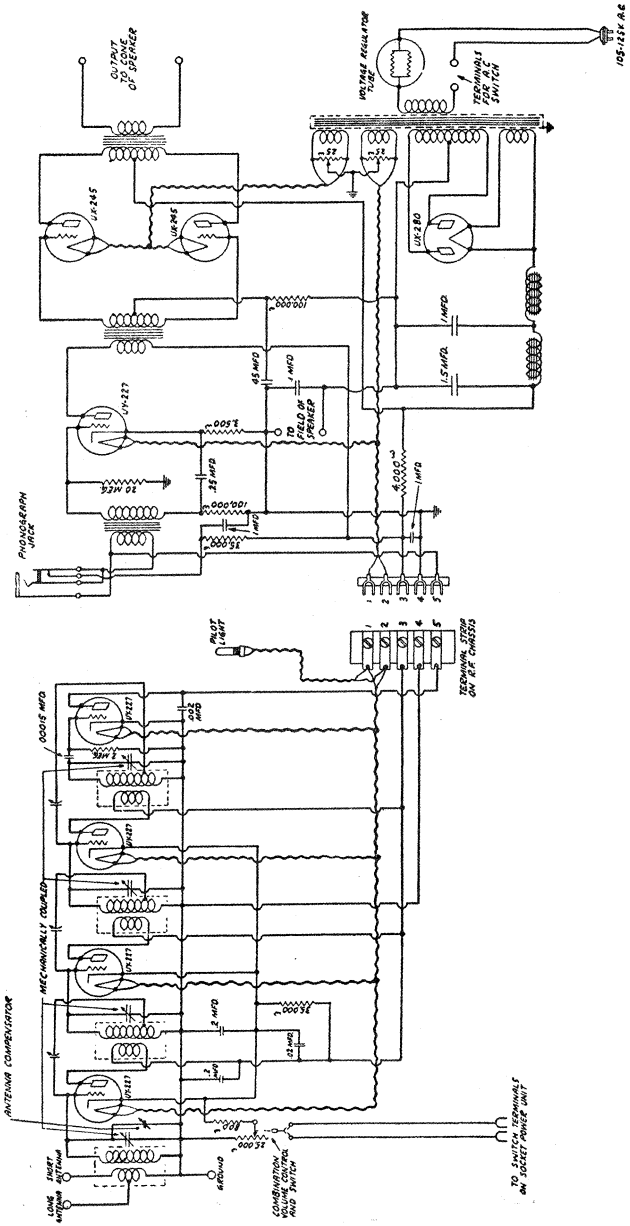
The power input transformer has a voltage regulator or ballast tube in series with the primary so that a constant voltage output is maintained at the various secondary terminals. A type 280 full wave rectifying tube is used. In the filter system two choke coils and two filter condensers of 1 and 1.5 mfd. are used. The entire negative B return current is sent through the field of the dynamic speaker, and the voltage drop taking place across this field then becomes the C-bias for the 245 power tubes. The 100,000-ohm resistor in the grid return of the push-pull transformer serves as a filter in connection with the .45 mfd. by-pass condenser.

TUBE VOLTAGES AT 120-VOLT LINE PRESSURE

Position	Type Tube	Fil. Volts	Plate Volts	Grid. Volts	Plate Mill's.
1st, 2nd and 3rd R.F.	227	2.5	150	12	5.5
Detector	227	2.5	45	0	3.4
1st Audio	227	2.5	145	9	3.6
2nd Audio	245	2.4	240	27	30

Two hum adjusting potentiometers are provided connected across adjacent to the 245 tubes, while the other one is between the last 227 socket and the first 245 socket. The adjustment of this control should be made only after the 245 hum balancer has been adjusted. If the hum persists and cannot be balanced out, it may be due to oscillation in one or several of the R.F. stages. The settings of the neutralizing condensers should not be altered except when it appears certain that the circuit really is unbalanced. A new set of tubes should always be tried first in every case.

BREMER-TULLY MODELS 81 AND 82



BREMER-TULLY — MODELS S-81 AND S-82

The Bremer-Tully models S-81 and S-82 are A.C. electric receivers with a screen grid radio frequency circuit. There are three stages of R.F. amplification with tubes of the 224 type, a power detector with a type 224 tube, a resistance coupled first audio stage, and an output stage with two type 245 tubes in push-pull. The total power consumption of the receiver is about 110 watts.

The tuning system consists of an antenna coupler and three R.F. transformers, all tuned with a 4-gang condenser. Complete individual shielding is employed in the R.F. amplifier, and this permits the use of small 2.5 mfd. coupling condensers between the R.F. stages so that a greater gain is secured. A local-distance switch is provided which completely disconnects the antenna and makes the receiver dependent entirely upon the pick-up from the ground connection. This permits of better graduation of volume on powerful local stations. Volume is controlled by means of a 3000-ohm variable resistor which regulates the screen grid voltage of the first two tubes. The volume control knob also operates the "on-off" switch for the receiver.

A power detector is employed with a type 224 tube, grid bias detection being used through the aid of a 25,000-ohm cathode biasing resistor which is shunted by a 1-mfd. bypass condenser. A .001 mfd. condenser bypasses the detector plate to cathode. The detector feeds into a resistance coupled first audio stage employing a .01 coupling condenser and a 1-meg grid leak. A 2000-ohm cathode biasing resistor is used shunted by a 1-mfd. condenser. In the second audio stage two type 245 tubes are used in push-pull. The grids of these tubes are biased with an 800-ohm resistor across the filament circuit. A 650,000-ohm resistor in series with a .004 condenser is connected across the grids of the two power tubes to level off any voltage peaks and prevent the emphasis of the higher-notes.

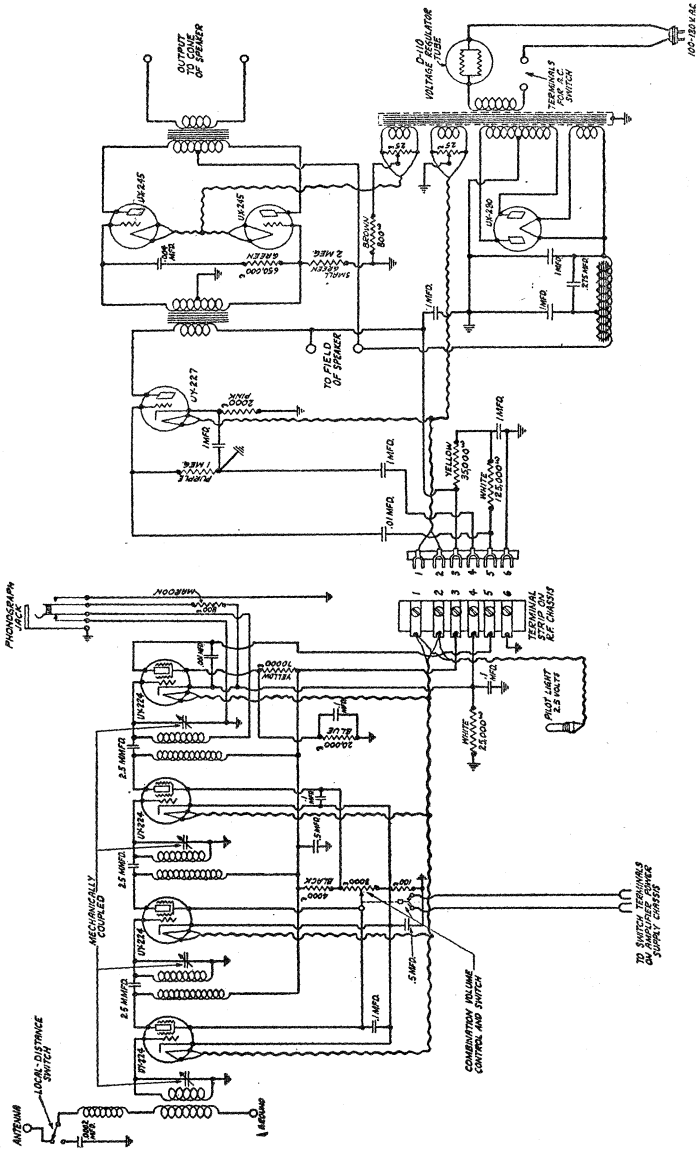
A phonograph pick-up jack is also provided. This is connected into the grid-cathode circuit of the detector tube. When the phonograph plug is inserted, the jack disconnects the R.F. amplifier from the detector and also connects an additional 800-ohm resistor in parallel with the normal cathode resistor. This reduces the effective biasing resistance to approximately 6000-ohms, and thus converts the detector tube into an audio amplifier.

The power supply is built up as a separate unit and is connected to the main chassis through a suitable terminal strip. A voltage regulator tube is used in series with the primary of the input transformer. A type 280 full wave rectifier is used. The filter choke is tapped and tuned so as to eliminate any 60 or 120-cycle A.C. hum. The values of all biasing and filter resistors and bypass condensers are clearly indicated in the circuit diagram. For a further discussion of the troubles and ills to which this receiver is due, see the page describing the Brunswick S-14, S-21 and S-31.

TUBE VOLTAGES AT 115 VOLT LINE PRESSURE

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's	Screen Volts
1st, 2nd and 3rd R.F.	224	2.5	151	2.9	1.7	65
Detector	224	2.5	117	5.0	.2	35
1st Audio	227	2.5	150	9.2	4.5	—
2nd Audio	245	2.5	240	50	45.	—

BREMER-TULLY MODELS S-81 AND S-82



STEWART-WARNER — MODELS 300 TO 390

Models 300 to 390 were the first battery operated receivers marketed by the Stewart-Warner Corporation of Chicago, Illinois. The 300, 310 and 325 models were 5-tube T.R.F. sets with three tuning dials and employing five type 201A tubes. Oscillations were controlled with a 200-ohm potentiometer connected across the filament circuit with the sliding contact joined to the grid returns of the first two tubes. A 4-ohm rheostat in the -A line served to control the filaments of all five tubes. The 310 and 325 models differ from the 300 in that they have a 2-way switch for connecting the speaker into the output of the fourth or fifth tube.

Models 330, 335 and 340 differ from the above only in that they were designed for dry cell tubes of the 199 type with the standard UV base and employ a 4½-volt A-battery. A 10-ohm rheostat in the -A line controls the filaments of all five tubes. Only 67½ volts plate pressure are used. A two-way switch is used in models 335 and 340 for connecting the speaker into the output of the fourth or fifth tube.

In models 305, 315 and 320 practically the same circuit arrangement is used, except that a different antenna coupler is used, consisting of a small primary and a tuned secondary. The advantage gained here is that somewhat sharper tuning is had through the looser antenna coupling. It also has a switch for cutting out the last audio stage.

Models 345, 350, 355 and 360 are a further development of the above models in that they employ an additional antenna coupling tube and have the three tuning condensers ganged so that only a single tuning dial is needed. An antenna choke coil is used which is connected directly across the grid and filament of the first tube. Volume control is effected by means of a 100,000-ohm variable resistor in series with the plate circuits of the three R.F. tubes. This resistor is bypassed by a .006-mfd. condenser. Grid resistors of 1000-ohms are used with the second and third tubes to suppress oscillations. A single 3-ohm rheostat controls the filaments of all six tubes. Another scheme for suppressing oscillations is the use of a shorted turn (absorption circuit) on the second and third R.F. transformers.

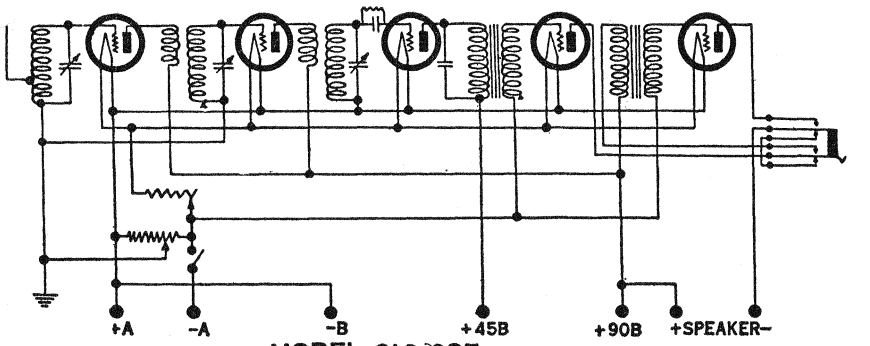
Models 385 and 390 are similar to the previous models except that they employ two filament rheostats, a master 6-ohm rheostat that controls all six tubes, and a 10-ohm rheostat for further controlling the three R.F. tubes. This latter rheostat thus serves as a volume control.

The troubles to which these receivers are subject are those typical of any battery operated receivers. Weak signals may be due to exhausted batteries, a poor tube, or to a defective antenna circuit. Noisy operation may be caused by a loose or broken joint, corroded battery contacts, or a defective antenna or ground connection.

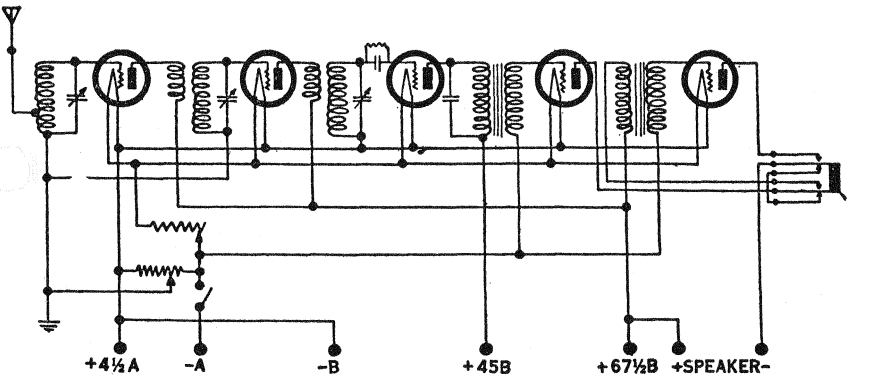
An improvement that can be made on all of these receivers is the installation of a power tube in the last audio stage, for this would enable the receiver to deliver a much better tone quality. Only two changes would have to be made, one being to bring out another Pos. B terminal so that a higher plate pressure can be applied to the last tube and the other to bring out the —F terminal of the second audio transformer to a special terminal so that the necessary C-bias can be supplied to the tube. Each of these additions is easily made and the improved results would well warrant the change.

If it is desired to operate any of these receivers from the A.C. lighting mains, the best method would be the use of a suitable A and B eliminator. If this is not desired, the entire circuit could be rewired for A.C. tubes, but this would be considerably more costly and after all would not give any superior results.

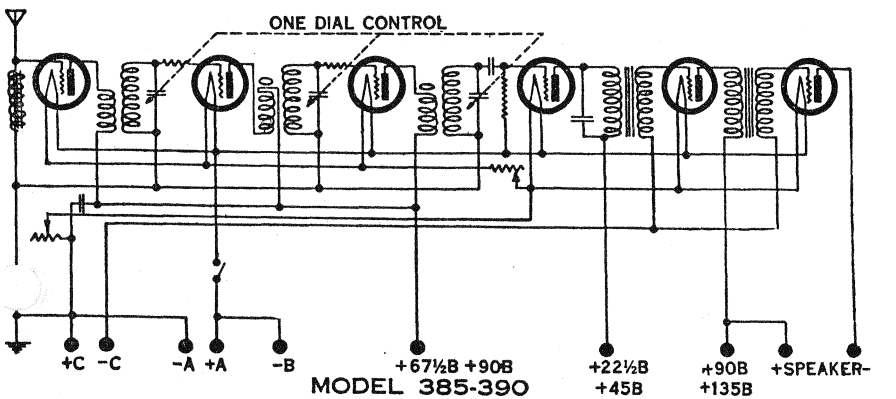
STEWART-WARNER MODELS 305—360



MODEL 310-325

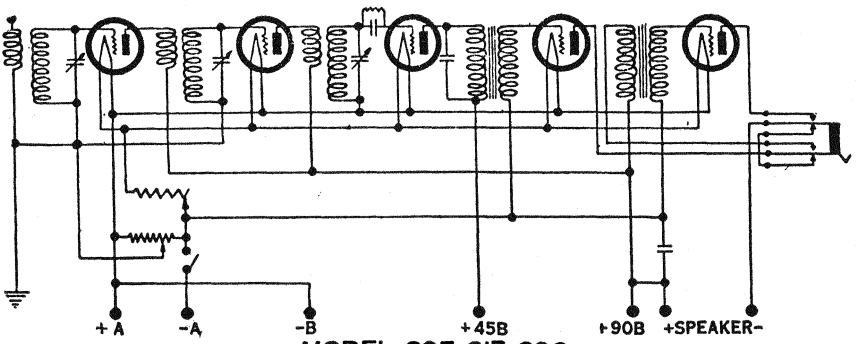


MODEL 335-340

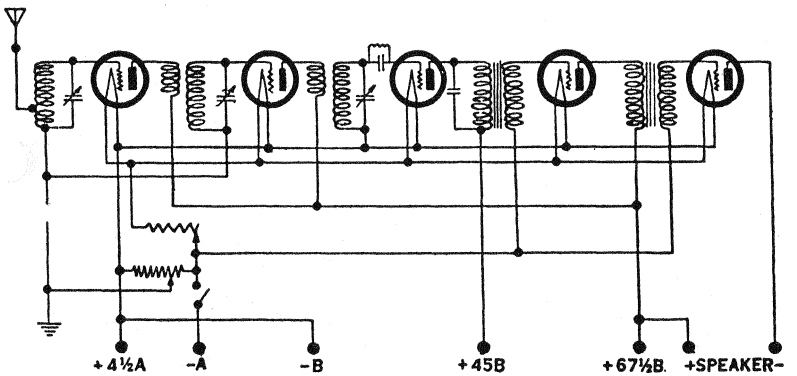


MODEL 385-390

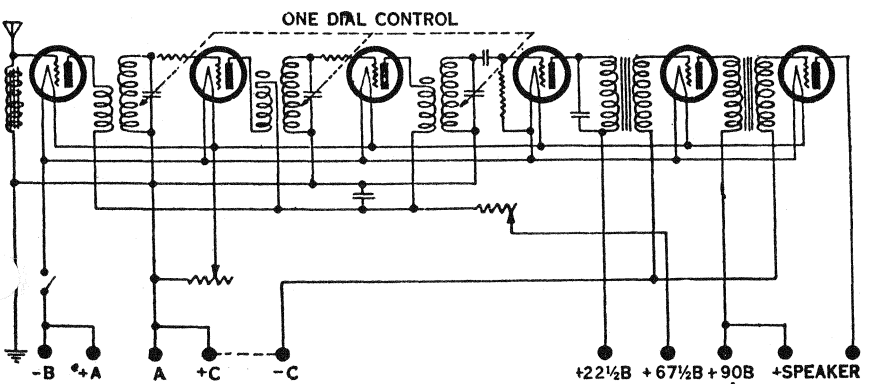
STEWART-WARNER MODELS 310—390



MODEL 305-315-320



MODEL 330



MODEL 345-350-355-360

STEWART-WARNER — MODELS 500 AND 700 D.C.

Models 500, 520 and 525 are 6-tube battery operated receivers arranged for single dial tuning control. They employ five type 201A tubes and one 112A tube in the output stage, although a 171A tube can also be used if the proper B and C voltages are supplied. A single fixed resistor of .58-ohms in the -A line is used to control the filaments of the six tubes. Volume is controlled by means of a 100,000-ohm resistor in the plate circuit of the first two tubes with a .006-mfd. bypass condenser to ground. Oscillations are suppressed with 1000-ohm resistors in the grid circuits of the three R.F. tubes.

The novel feature of the circuit is the antenna coupler, which consists of a tapped primary for antennas of different lengths and a tuned secondary that has at its grid end a small rotor connected in series. This has a small variometer effect, and serves as an antenna compensator. Two R.F. transformers are used for coupling the second and third tubes, these transformers together with the antenna coupler being tuned by a 3-gang condenser. Otherwise the circuit is very simple and straight-forward and not readily subject to any serious ills or troubles.

Models 700, 705 and 710 are also 6-tube battery sets, but employ compartment shielding to separate the successive stages from each other. The advantages gained through this shielding are: greater radio frequency gain with less danger of oscillation, greater sensitivity, greater selectivity and less interference due to local pickup. All R.F. tubes are provided with 3.6-ohm fixed filament resistors. The detector employs a standard 30-ohm rheostat. The two audio stages use one resistor of 1.65-ohms.

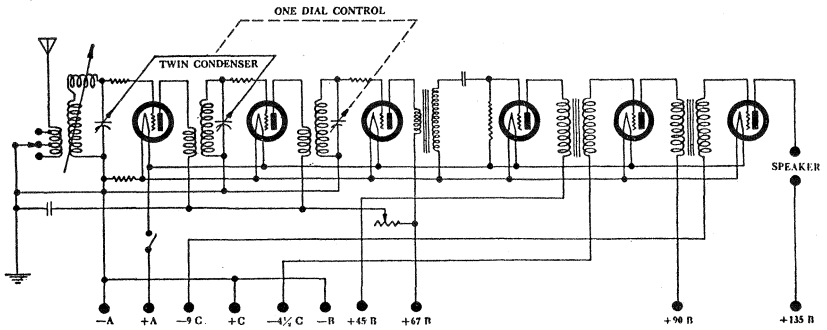
An interesting feature of the circuit is the coupling system employed in the R.F. amplifier. This is a combination capacity and inductance coupling so that more uniform amplification and greater operating stability is had over the entire wave length range. Plate current is supplied to the three R.F. tubes through three 60 millehenry R.F. choke coils, while the signal oscillations themselves pass on through the primaries of the coupling coils. In series with these primaries are variable condensers which are operated in unison with the main tuning condensers. Grid bias detection is employed in the detector circuit obtained by means of a 1½ to 3-volt C-battery in series with the grid lead.

The receiver uses five 201-A tubes and a power tube of the 112A or 171A type in the output stage. The type of tube used will determine the plate and grid voltages required. Volume is controlled with a 175,000-ohm variable resistor in series with the plate circuits of the three R.F. tubes.

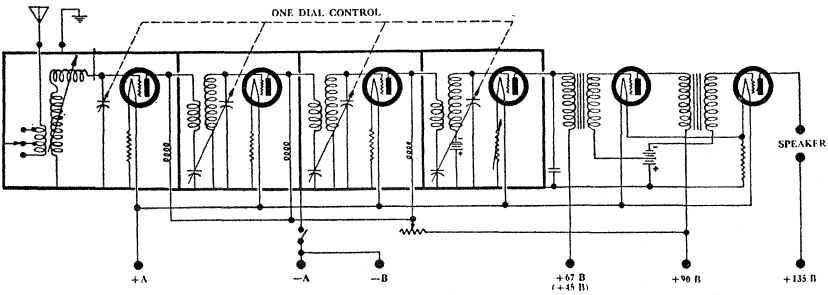
The main source of trouble in this receiver is the unbalancing of the four-gang tuning condenser. Unless all tuned circuits are in perfect phase, the signals will have difficulty in getting through and the volume output of the set will be low and the receiver will be poor for distance reception. The radio frequency amplifier can be balanced by tuning in a weak station (preferably a distant station) and then adjusting the individual condensers until the signal comes through with maximum intensity. A more satisfactory system would be the use of a modulated oscillator so that the receiver could be balanced at both the higher and lower frequencies.

In addition the receiver is subject to the ills that are common to any battery operated receiver, such as loose joints, corroded battery contacts, weak signals due to exhausted batteries, etc. Best tone quality will always be had if a power tube of the 171A type is used in the output stage. Or if desired, a modern combination electric B-power unit and power amplifier can be used and the last stage of the receiver not used at all.

STEWART-WARNER MODELS 500—710

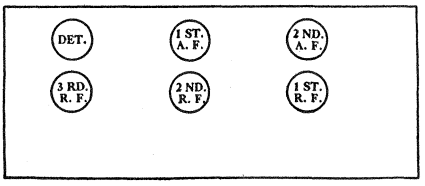


Model 500, 520, 525



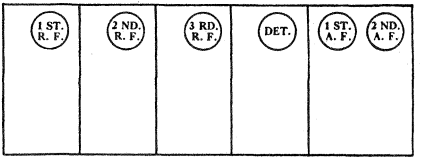
Model 700, 705, 710

LOCATION OF VARIOUS TUBES



Model 520, 525

LOCATION OF VARIOUS TUBES



Model 705, 710

STEWART-WARNER—MODELS 530, 535 & 715, 720 A.C.

The 530 and 535 models are A.C. receivers employing type 226 tubes in the three radio frequency and first audio stages, a 227 in the detector, and a 171A tube in the second audio or output stage.

The tuning system consists of an antenna coupler and three R.F. transformers, all tuned with a ganged 4-section condenser. The antenna coupler has a tapped primary and a secondary that has connected in series with it at the grid end a small rotor which serves as an antenna compensating inductance.

Two 1½-volt filament circuits are used, one for the three R.F. tubes and one for the first audio tube. A 20-ohm center-tapped resistor is across the R.F. filament circuit with a 1700-ohm biasing resistor connected from the center tap to ground. A .01 condenser bypasses this resistor. Across the audio filament is another 20-ohm resistor with a 5100-ohm biasing resistor between the center tap and ground. A similar resistor is across the detector filament with the center tap connected directly to ground. The cathode of this tube is also grounded. Volume is controlled by means of a 10,000-ohm variable resistor in series with the secondary of the first R.F. transformer. A resistor of 1000-ohms is used in the grid circuit of the first R.F. tube and 1900-ohms in the second and third R.F. tubes to suppress oscillations. A type 171A tube with standard output transformer is used in the second audio stage. The remainder of the circuit is of standard design and construction.

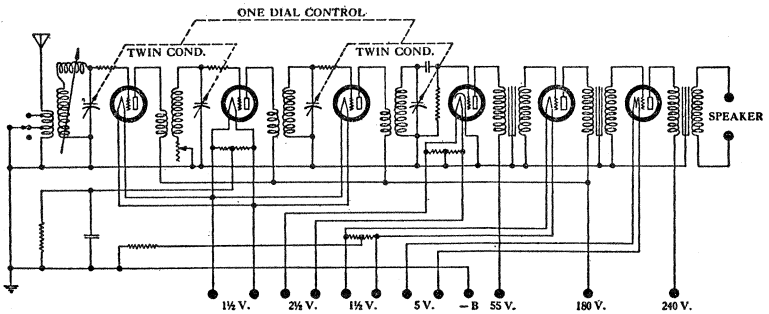
The 715 and 720 models are also 6-tube A.C. receivers employing type 226 tubes in the three R.F. and first audio stages, a 227 tube in the detector, and a type 171A tube in the second audio or output stage. Four shielding compartments are used for the three R.F. and detector stages. Volume is controlled with a 10,000-ohm variable resistor connected from the antenna terminal to the grounded shield. Single-dial tuning is employed.

A combination of inductance and capacity coupling is used in the R.F. stages. Plate current is supplied to the tubes through 60-millehenry choke coils, while the signal oscillations pass on through the primaries of the coupling coils. In series with these primaries are variable condensers which are operated in unison with the main tuning condensers. A 4-gang condenser is used for tuning all four secondaries.

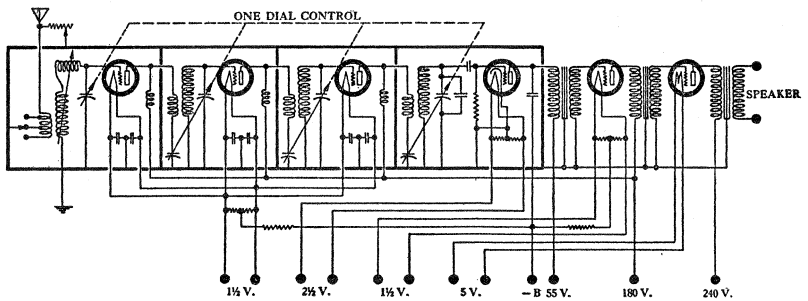
Each filament of the three R.F. tubes is shunted by a filter consisting of two .006 condensers in series and the midpoint grounded. A 20-ohm center-tapped resistor is connected across the 1½-volt R.F. filament circuit with a 1700-ohm biasing resistor from the tap to the ground. Another 20-ohm resistor is connected across the first audio filament circuit with a 5100-ohm biasing resistor from the tap to ground. A similar 20-ohm resistor is also connected across the detector filament, but here the center tap is grounded, as is also the cathode and the grid leak return lead. A standard output transformer is used to couple the plate of the last tube to the speaker.

The same power supply unit is used for all four receiver models, 530, 535, 715 and 720. This unit contains a transformer with five filament secondaries and a high-voltage plate supply secondary. The primary is designed for a 115-volt A.C. line. If the line pressure is higher, some form of line ballast must be used in order to reduce the transformer input to 115. In the filter system a double choke is used in connection with a 3-section condenser block. This block also contains the necessary bypass condensers for the voltage dividing system. The color code for the various leads to the attachment plug is given in the accompanying circuit illustration. In case of hum, check the center tapped resistors and the filament filter condensers.

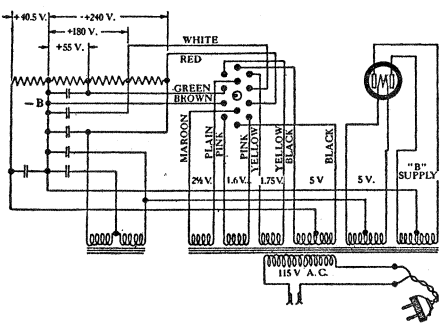
STEWART-WARNER MODELS 530—720



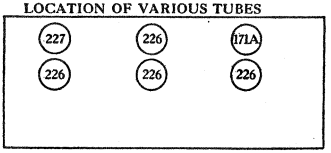
Model 530, 535



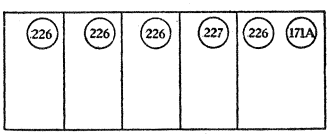
Model 715, 720



LOCATION OF VARIOUS TUBES



Model 530, 535



Model 715, 720

STEWART-WARNER — SERIES 800 MODELS

Models 801 and 802 are 6-tube A.C. operated receivers employing type 226 tubes in the three R.F. and first audio stages, a type 227 in the detector and a 171A in the output stage. A standard output transformer is used to couple this tube to the speaker. The tuning system consists of an antenna coupler and three R.F. transformers, all tuned with a 4-gang condenser. Three antenna terminals are provided, one for short antennas which is connected directly to the primary of the coupler, another for long antennas which has a .0001 condenser in series, and a third for using the A.C. line as an antenna and this has a .0001 mica condenser in series.

Oscillations are suppressed by means of 1000-ohm resistors in the grid circuits of the three R.F. tubes. Volume is controlled by means of a 5000 variable resistor in series with the secondary of the second R.F. transformer. Phonograph pick-up jacks are also provided, these being connected directly across the grid and cathode of the 227 detector tube. A .001 bypass condenser is connected from the detector plate to ground and a .25 condenser from the detector B-supply to ground. A .25 condenser is used from the common R.F. plate supply to ground, and a .25 from one side of the R.F. filament circuit to ground. All center-tapped filament resistors and grid bias resistors are built directly into the power pack, so that the receiver wiring itself is quite simple.

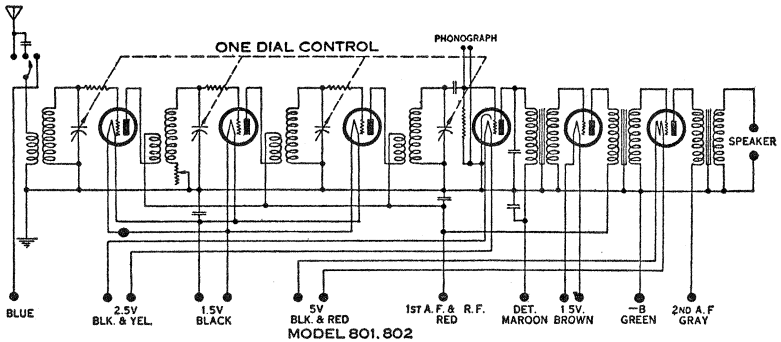
Models 801, 801-A, 811, and 811-A, series B, are similar in every respect to models 801 and 802 with the exception that in the output stage two 171A tubes are used in push-pull. This eliminates much overload distortion and yields an improved tone quality all around. The center-tapped filament resistors as well as the various biasing resistors are all built directly into the power pack, which greatly simplifies the wiring in the receiver itself.

The power supply units for both of the above groups of receivers are very similar, except that in the case of the single output tube a 2000-ohm biasing resistor is used while for the two push-pull tubes a 1000-ohm resistor is used. The power transformer has a primary tapped for 110 and 120 volts, and six secondary windings. A type 280 full wave rectifier is employed. In the filter system two chokes and a 3-section condenser block are used. The entire power unit is of standard design and construction. The R.F. grid bias resistor is 2000-ohms, and the 1st audio 4000-ohms.

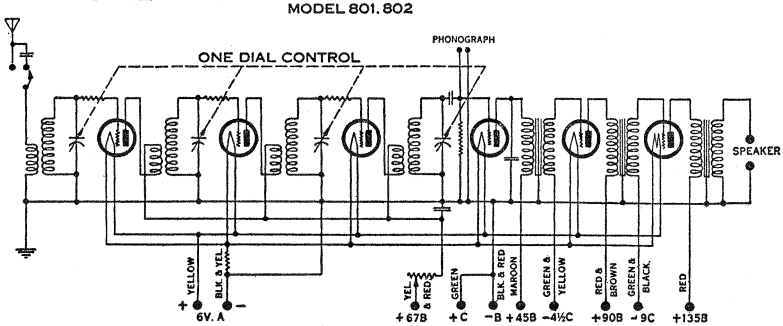
Models 806, series B, are D.C. battery operated receivers employing 201A tubes throughout and two 112A tubes in push-pull in the output stage. The circuit arrangement is very similar to the A.C. receivers, with only the necessary changes in the filament circuits. A single filament resistor of .58 -ohm controls the voltage supplied to all of the tubes. Volume is controlled by means of a 200,000-ohm variable resistor in series with the plate supply to the three R.F. tubes. This resistor is bypassed to ground with a .1-mfd. condenser. Phonograph pick-up jacks are also provided, these being connected across the grid and filament of the detector tube. If it is desired to use type 171A tubes in the output stage, this can be arranged by using 180 volts plate pressure and 40 volts grid bias.

In case a prominent hum appears in the A.C. receivers, this may be caused by one of the center-tapped resistors having become open or the tap not being at the correct center. In most cases conditions can be improved by replacing the resistors with others having a sliding tap so that adjustments can be made for any unbalancing of the circuits. Bypass condensers of 1 mfd. capacity connected across the various B-voltage taps will also help in most cases.

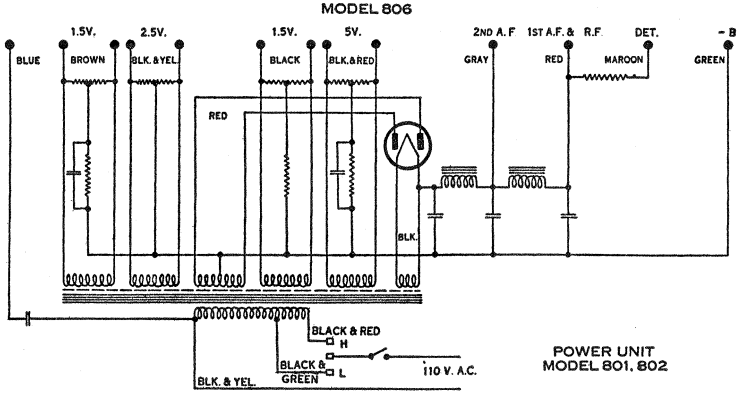
STEWART-WARNER 800 SERIES



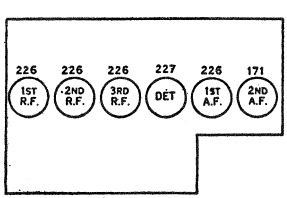
MODEL 801. 802



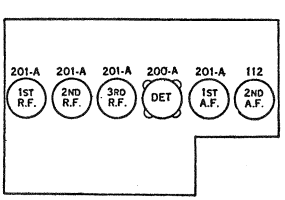
MODEL 806



POWER UNIT
MODEL 801. 802



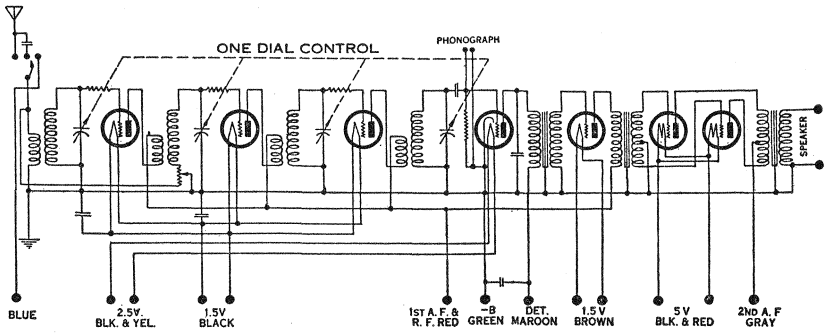
MODEL 801. 802.



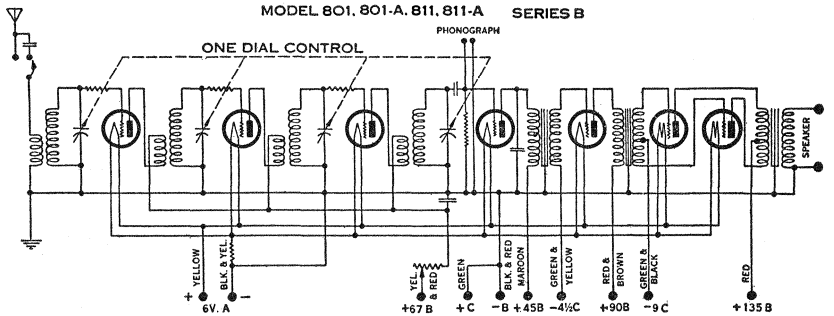
MODEL 806

LOCATION OF VARIOUS TUBES

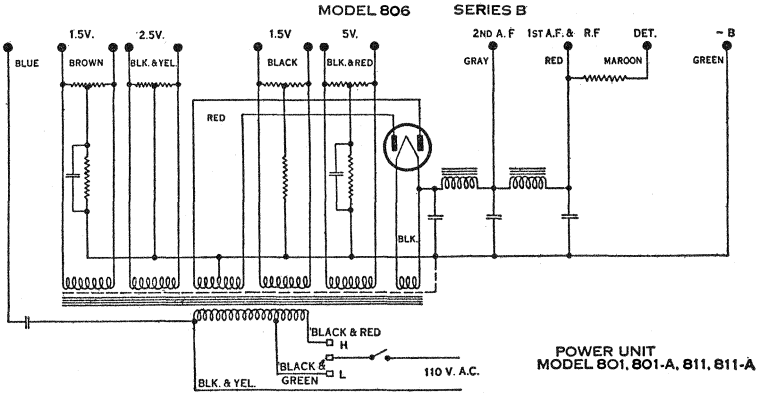
STEWART-WARNER 800 SERIES B



MODEL 801, 801-A, 811, 811-A SERIES B



MODEL 806 SERIES B



POWER UNIT
MODEL 801, 801-A, 811, 811-A

STEWART-WARNER SERIES 900 RECEIVERS

The Stewart-Warner 900 series A.C. receiver is of the balanced bridge type and has three stages of tuned radio frequency amplification employing type 227 tubes, a tuned detector and transformer coupled first audio stage each employing a type 227 tube, and a second audio stage with two type 245 tubes in push-pull.

The circuit differs from the usual type in that it makes use of a shunt feed to the plates of the R. F. tubes through separate choke coils and by-pass condensers. In this way the radio frequency and power circuits are separated and greater stability is obtained. The bypass condensers have a capacity of .006 mfds. The tuning system consists of an antenna coupler and three R.F. transformers all tuned with a 4-gang condenser each section of which is provided with an individual trimmer. Volume is controlled by varying the bias with a 6,000-ohm variable resistor in series with the cathode circuit of the three R.F. tubes. A 200-ohm fixed resistor is also in series with the circuit in order to prevent the bias from being reduced below the required minimum.

In the detector circuit grid rectification is employed through the aid of a .00025 grid condenser and 1 megohm grid leak. A .002 mfd. condenser bypasses the detector plate to the cathode, which in turn is connected directly to the ground. A standard audio transformer couples the detector to the first audio stage employing a 227 tube. The grid of this tube is biased with a 2400 ohm resistor connected between the cathode and ground and bypassed with a .25-mfd. condenser. A standard input and output transformer are used in the last audio stage employing two type 245 power tubes. The grids of these tubes are biased by means of an 850-ohm resistor connected between the ground and the center tap on a 20-ohm filament resistor. The output transformer is arranged so that either a magnetic or dynamic speaker can be operated from the receiver.

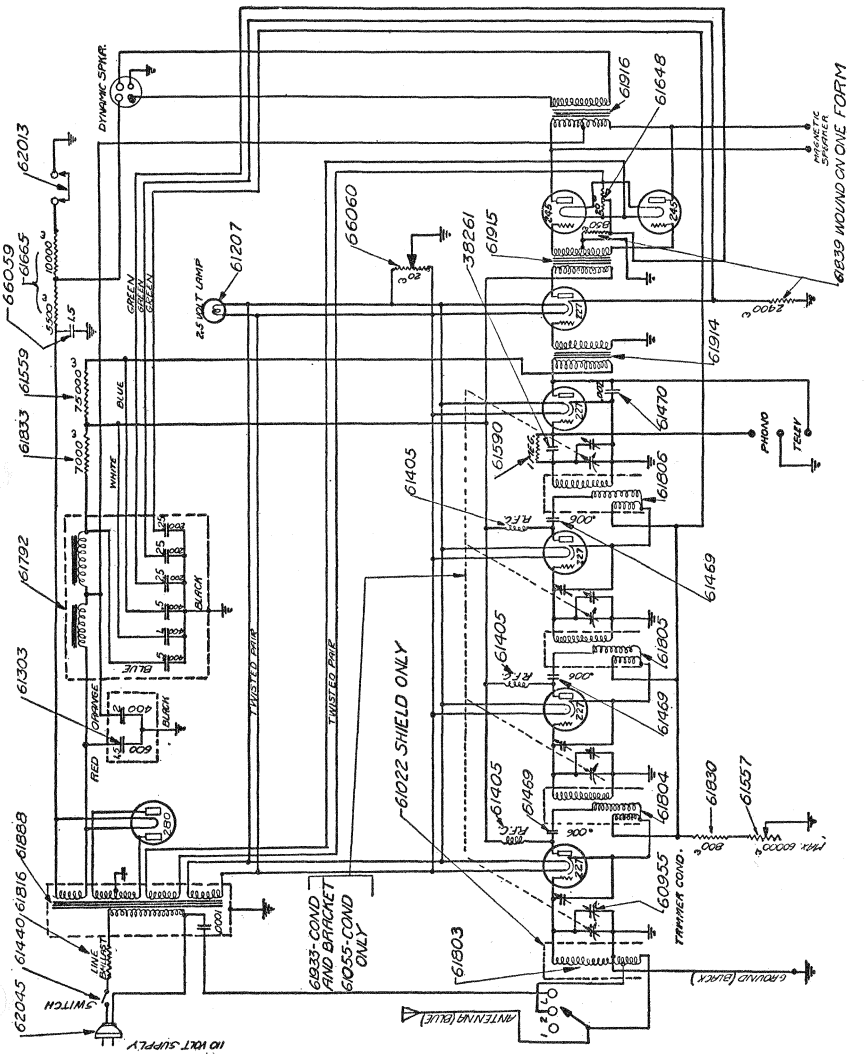
Phonograph pick-up jacks are also provided connected to the input of the detector tube, this arrangement making available the additional amplification of the tube. However, the phonograph pick-up wires must be disconnected when radio reception is wanted. Inserting a switch in these leads is not satisfactory, for this would throw the tuned detector circuit of the radio receiver out of phase due to the capacity of the pick-up leads, with a resulting loss of volume and selectivity.

The power supply unit is of standard design and construction. The input transformer has a line ballast in series with the primary to take care of any line voltage fluctuations. There are four secondary windings, two 2½-volt filament windings, a 5-volt filament winding for the 280 rectifying tube, and a high voltage center-tapped winding. The winding supplying the first five tubes has a 20-ohm hum control resistor across it with the center tap grounded. The filter system comprises two chokes and a 3-section condenser of 1.5, 2 and .5 mfds. Two voltage resistors are used of 7000 and 75000 ohms for the amplifier and detector tubes respectively.

TUBE VOLTAGES

Position	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st, 2nd & 3rd R. F.	227	2.2	132	8.5	3.8
Detector	227	2.1	32	0.0	2.8
1st Audio	227	2.2	132	7.5	5.4
2nd Audio	245	2.25	226	47.5	26
Rectifier	280	4.7	—	—	90

STEWART-WARNER MODEL 900 A.C.



STEWART-WARNER No. 950 D.C. AND BATTERY SCREEN GRID

The No. 950 battery operated screen grid receiver is a 7-tube set employing type 222 tubes in the three R.F. stages, a type 201-A tube in the detector and first audio stage, and two 112-A or 171-A tubes in push-pull in the second audio or output stage. Filament current is supplied to all tubes by a 6-volt storage battery, and the 180-volt plate pressure by four 45-volt B-batteries connected in series. A 40-volt C-battery is also needed for the 171-A output tubes.

Volume is controlled with a dual resistor consisting of a 1000-ohm unit in the antenna-ground circuit and a 100,000-ohm unit in the screen grid circuit of the three R.F. tubes. In series with the -A line is a tapped filament resistor the first section of which also serves as a grid biasing resistor for the three R.F. tubes. All bypass condenser and resistor values are given on the accompanying circuit diagram. The receiver is designed for use with a 6-volt dynamic speaker, a special socket and plug being provided for connecting the voice coil and field into the circuit. Provisions are also made for operating a magnetic cone speaker if desired.

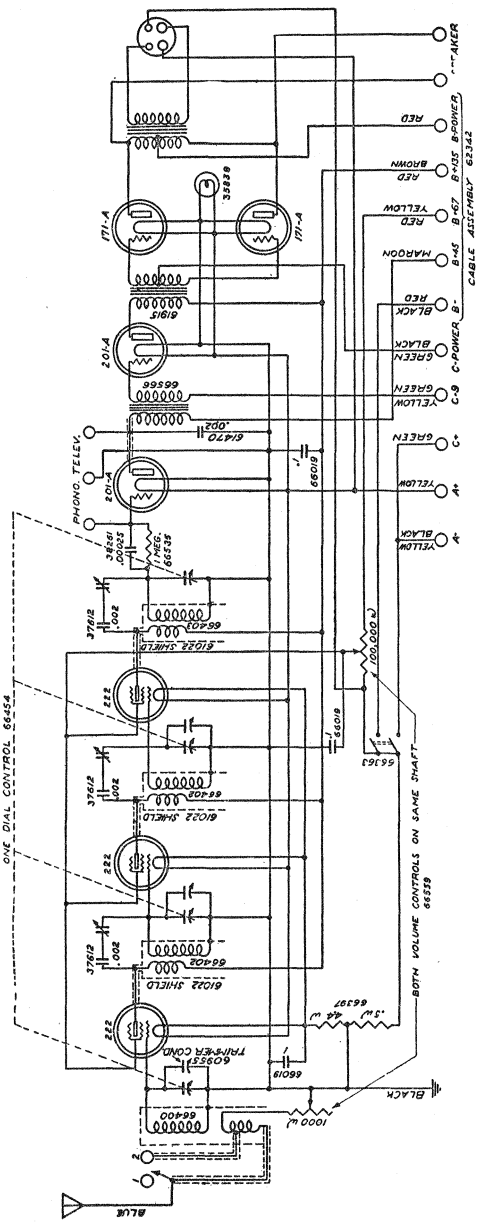
In case the set fails to perform properly, the trouble may be due to weak or exhausted A or B batteries, corroded battery terminals, or poor screen grid tubes. Of course, a defective resistor or condenser may also develop, or one of the soldered joints may have become loose or corroded. Lack of volume may also be due to the gang condenser not being properly balanced. The special coupling condensers are adjusted and permanently set at the factory, and no attempts should be made to alter their settings at any time, for their adjustment is very critical.

The 950 D.C. screen grid receiver is also a 7-tube set but designed for operation from a 110-volt direct current line. In the R.F. amplifier three type 222 tubes are used, the coupling system being a combination of inductance and capacity coupling so that uniform amplification is had over the entire wave length range. The coupling condensers are adjusted permanently at the factory and should not be altered under any conditions. A dual volume control is used consisting of a 1000-ohm unit in the antenna-ground circuit and a 100,000-ohm unit in the screen grid circuit of the R.F. tubes. The values of the various resistors and bypass condensers are all given in the accompanying circuit diagram.

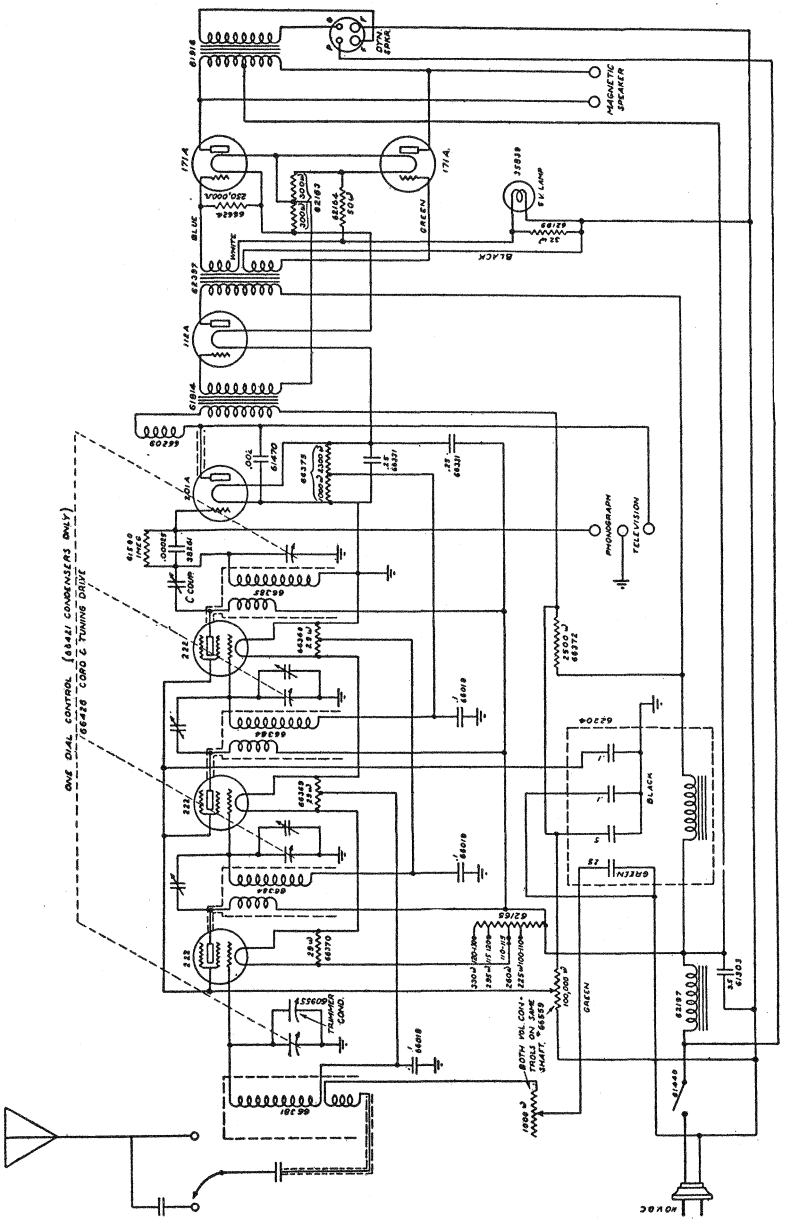
The power supply unit is very simple, and consists merely of a filter system and the necessary voltage resistors. The tube filaments are all connected in series, but in parallel with each filament of the 222 tubes is a 29-ohm resistor. The current through this resistor plus the current through the filament just equal one-fourth ampere, the current required by the other tubes. A series of taps are provided to take care of different line voltages ranging from 100 to 130 volts. Provisions are made for operating either a 100-volt D.C. dynamic speaker or a magnetic speaker.

In the selection of tubes for a series filament circuit of this kind it is very important that tubes with uniform filament characteristics be chosen. Also, the filament circuit is likely to be the chief source of trouble, for any break or high resistance contact will at once render the entire circuit inoperative. Another source of trouble is a broken down or corroded resistor among the numerous ones used. In case the set has a tendency to pick up line noises, the use of a radio frequency choke coil in the line will help in keeping out these noises. Also, the plug must be inserted into the outlet the right way, or the circuits will not have the proper polarity and the set will fail to perform.

STEWART-WARNER 950 BATTERY S. G.



STEWART-WARNER MODEL 950, D.C.



STEWART-WARNER No. 950 A.C. SCREEN GRID

The Stewart-Warner No. 950 A.C. screen grid receiver is an 8-tube set employing three type 224 screen grid tubes in the R.F. amplifier, a 227 tube in the detector and first audio stages, and two type 245 tubes in push-pull in the second audio or output stage. A type 280 full wave rectifying tube is used in the power unit.

The unusual feature of the tuning system is the combination inductance and capacity coupling that is used, this producing a practically uniform sensitivity over the entire wave length range. The coupling capacities are small adjustable condensers on the right side of the main tuning condensers. They are adjusted and sealed at the factory and should never be altered under any conditions. A power detector with a type 227 tube is used to handle the output of the radio frequency stages. This detector feeds into a resistance coupled stage of audio amplification, and this in turn feeds into a push-pull stage using two 245 power tubes.

The power unit consists of an input transformer with a line ballast in series with the primary, a type 280 full wave rectifier, and two filter chokes and voltage resistors with the necessary filter and bypass condensers. The receiver output is designed for operating a 200-volt D.C. dynamic speaker, the field being excited directly from the receiver power unit. A magnetic speaker can also be used by connecting it directly across the plates of the two output tubes.

Provision is also made for plugging in a phonograph pick-up. This is connected across the grid and grounded cathode terminal of the detector tube, a special 100,000-ohm coupling resistor bypassed by a .001 condenser being connected into the grid circuit. This connection makes available the amplification of the tube, but the pick-up wires must be removed from their receptacles if radio reception is wanted.

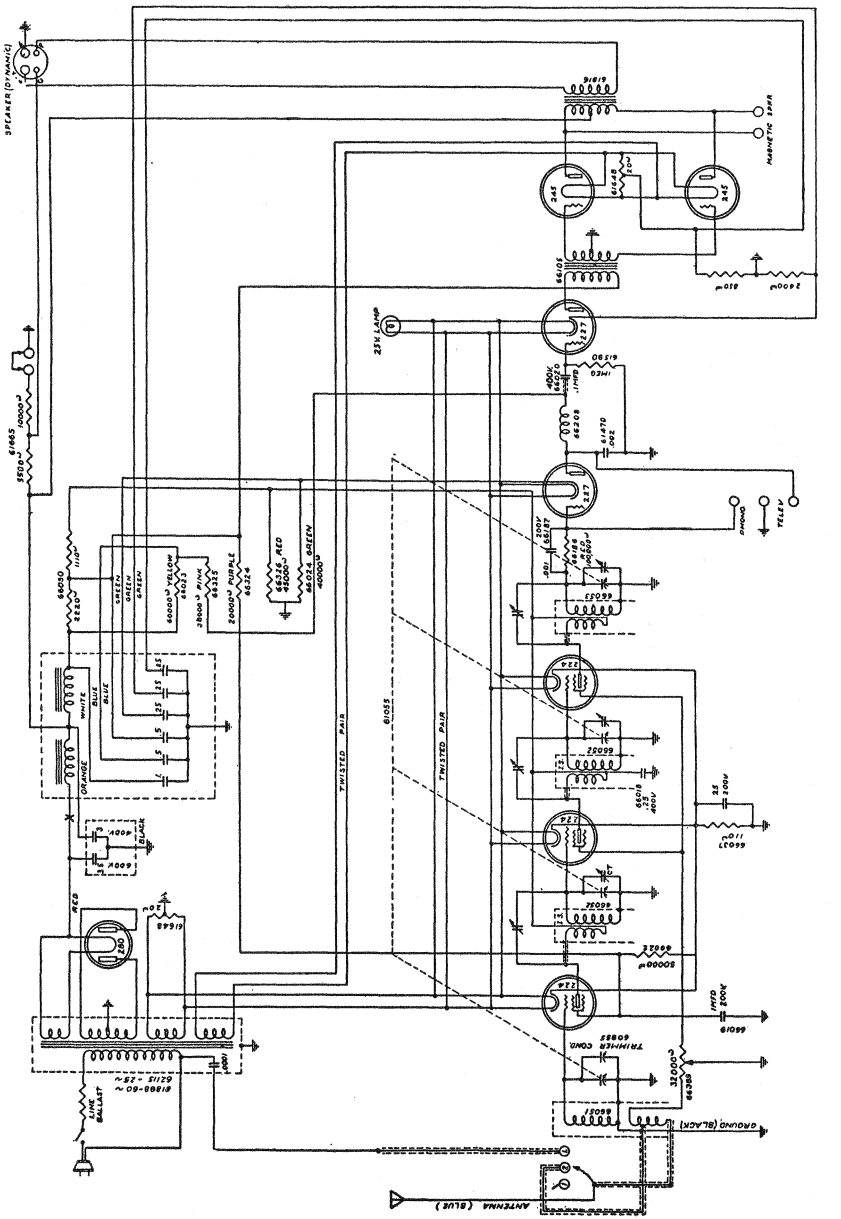
If the receiver has a tendency to oscillate, this may be due to an open screen grid bypass condenser, in which case violent oscillations will occur over the entire wave length band. An open R.F. bypass condenser may also be the cause, but then oscillations will be more pronounced at the higher wave lengths. An open R.F. grid bias condenser will cause oscillations accompanied by a blurring tone. Excessive screen grid voltage over 85 volts may cause the set to oscillate. Oscillations may also be due to poor contact at the grounding clips on the condenser rotor shaft.

A poor ground may cause oscillation. This can be checked by testing the resistance of the ground circuit or trying another ground. Oscillations may also be due to feedback caused by having the aerial wire too close to the terminal strip in the rear of the set. This condition can be overcome by keeping the various wires separated from each other and having them lead directly to the set.

An important point to observe is that the metal bottom is always returned and screwed on tightly after it was removed, for it plays a very important part in the shielding of the circuits. The gang condenser has been very carefully phased or aligned at the factory, and only in rare cases will any readjustments of the phasing trimmer condensers be necessary, such as when the relative position of the wiring of the tuned circuits was varied, or a coil other than the antenna coil replaced, or the condenser plates were bent due to careless handling. The coupling condensers are not so affected, and must not be touched.

Weak reception may be due to a poor or open antenna or ground circuit, a defective tube, low line voltage, or to the shielding effect of the building in which the receiver is installed. Poor tone quality may be caused by a defective tube, incorrect grid biases, or a defective speaker. Noisy operation generally is due to external interference, a loose connection, or to a defective electric appliance on the line.

STEWART-WARNER MODEL 950 A.C.



STEWART-WARNER MODEL R100—A, B & E

The Stewart-Warner R-100 models are 8-tube A.C. electric receivers employing three stages of tuned R.F. amplification with tubes of the 224 type, a tuned grid bias or power detector and resistance coupled 1st audio stage each employing a 227 tube, and an output stage with two 245 tubes in push-pull. The R. F. and detector stages are tuned with a 4-gang condenser. A small semi-fixed condenser is connected from the plate of each R.F. tube to the grid of the next tube. These condensers provide a slight amount of capacity coupling, increase the gain at the higher frequencies, and in this manner insure a more uniform amplification over the entire frequency range. These condensers are adjusted and correctly set at the factory and must never be tampered with under any conditions. The R.F. transformer primaries are resonated so as to produce maximum amplification at the lower frequencies. Volume is controlled by means of a 32,000-ohm variable resistor which controls the resistance of the antenna circuit as well as the screen grid voltage of the three R.F. tubes.

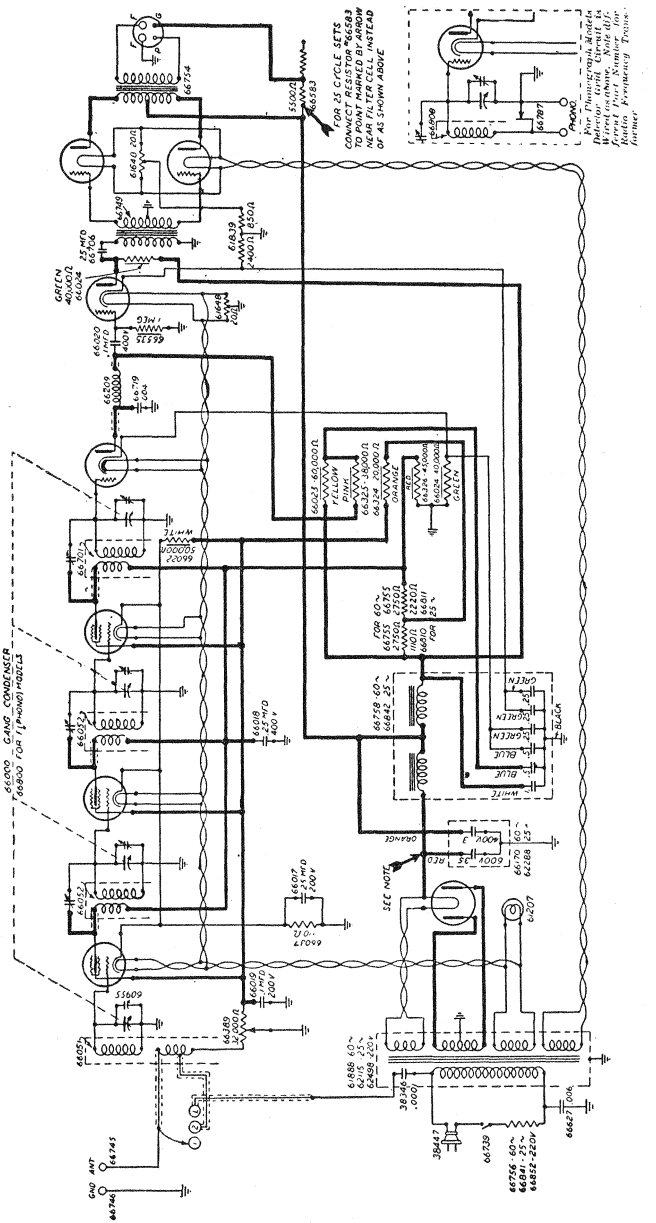
A 40,000-ohm cathode resistor is used for biasing the grid of the detector tube. In the plate circuit an R.F. choke is used in connection with a .004 bypass condenser to ground. The coupling unit consists of a plate resistor (two units of 38,000 and 60,000 ohms in series), a .1-mfd. condenser, and a 1-megohm grid leak. In the plate circuit of the first audio tube a 40,000-ohm plate resistor is used and a .25-mfd. condenser for coupling the tube to the primary of the audio transformer. This arrangement bypasses the plate current out of the transformer primary and thus eliminates the magnetic saturation of the core. A better tone quality results. The grid of the tube is biased through a 2400-ohm cathode resistor. In the push-pull stage a 20-ohm center tapped filament resistor is used with an 850-ohm grid biasing resistor connected from the tap to the ground. The output transformer is connected through a socket and plug to the voice coil of the dynamic speaker. The B-supply line to the power tubes also provides the speaker field current through a 5500-ohm series resistor.

The power supply system has an input transformer with a voltage stabilizing resistor in series with the primary. There are three filament supply secondaries and a high voltage plate supply winding. On leaving the filter circuit the B line divides, and one branch leads directly to the plate circuit of the first audio tube, while another leads to the detector plate circuit. A third branch leads through a 2750-ohm unit and then subdivides, one sub-branch going through a 20,000 unit to the screen grids of the R.F. tubes and through an additional 50,000-ohm unit to the cathode return circuits of these tubes as a bleeder circuit. The other sub-branch also passes through a 2750-ohm unit to the plates of the R.F. tubes and through another 45,000-ohm resistor to the ground as another bleeder for stabilizing the circuit. The cathodes of the R.F. tubes are finally grounded through a 110-ohm biasing resistor which is bypassed by a .25-mfd. condenser.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of tube	Type Tube	Fil. Volts	Plate Volts	Grid Bias	Plate Mill's	Screen Grids
1st R.F.	224	2.16	160	1.7	—	79
2nd R.F.	224	2.18	160	1.7	—	79
3rd R.F.	224	2.2	160	1.7	—	79
Detector	227	2.18	175	23	—	—
1st Audio	227	2.18	125	9	—	—
2nd Audio	245	2.25	250	50	—	—
2nd Audio	245	2.25	250	50	—	—
Rectifier	280	4.7				

STEWART-WARNER MODEL R-100



CROSLEY MODELS 401, 401A AND 601

The Crosley Bandbox Jr. Model 401 is a 4-tube battery operated receiver housed in an all-metal table cabinet. The circuit employed includes a stage of tuned R.F. amplification, a regenerative detector, and two transformer coupled audio stages. The first three tubes are of the 199 type, while the last or output tube is a 120. Regeneration is controlled through a small variable condenser coupling the plates of the detector and R.F. tube. Volume is controlled with an auxiliary rheostat in the filament circuit of the R.F. and detector tubes. Any model Musicone can be used with the receiver.

The batteries required for operating the receiver are three No. 6 dry cells connected in series or a 4-volt storage battery, three 45-volt B-batteries, and a 22½-volt C-battery with a 4½-volt tap. The color code of the battery cable is: Black, A—, B—, C+; Blue, B+ (67½) detector and R.F. tubes; White, B+ (90) 1st audio; Red, B+ (135) 2nd audio; Brown, C— (4½) 1st audio; Green, C— (22½) 2nd audio; Yellow, A+. The ground must not be connected to any of the battery terminals.

The Bandbox Jr. Model 401A is a 5-tube battery operated receiver. It employs an untuned antenna coupler followed by one stage of neutrodyned R.F. amplification, a tuned regenerative detector, and two stages of transformer coupled audio amplification. The first four tubes are of the 199 type and the output tube a 120. Regeneration is controlled with a small condenser coupling the plates of the detector and R.F. tubes. Volume is controlled with an auxiliary rheostat in the filament circuits of the detector and R.F. tubes.

The batteries needed for the receiver are three dry cells in series or a 4-volt storage battery, three 45-volt B-batteries, and a 22½-volt C-battery with a 4½-volt tap. The color code of the battery cable is the same as for Model 401 given above. The ground must not be connected to any of the battery terminals.

BANDBOX MODEL 601

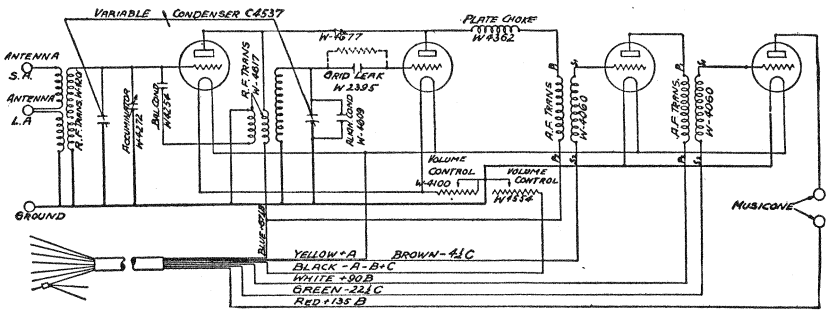
The No. 601 Bandbox is a 6-tube storage battery set employing three stages of neutralized tuned R.F. amplification, a non-regenerative detector, and two stages of transformer coupled audio amplification. The first five tubes are of the 201A type, while the output tube is a 171A. Volume is controlled with a rheostat in the filament circuit of the R.F. tubes. Small auxiliary condensers called acuminators shunted across the second and third stage tuning condensers serve in sharpening the tuning when critical selectivity is required. For aligning the tuning condensers a small auxiliary condenser is provided shunted across the detector section. Any model Crosley Musicone can be used with this receiver. If a 171A tube is used with 180 volts on the plate, the type E Dynacone is recommended for greatest volume and best reproduction.

The batteries required for this receiver are a 6-volt storage battery, four 45-volt B-batteries, and two 22½-volt tapped C-batteries. The color code of the battery cable is: yellow, A+; black, A—, B—, C+; blue, B+ (45) detector; white, B+ (90) R.F. and 1st audio; red, B+ (180) output; brown, C— (4½) 1st audio; green, C— (40) output stage. The ground must not be connected to any battery terminal.

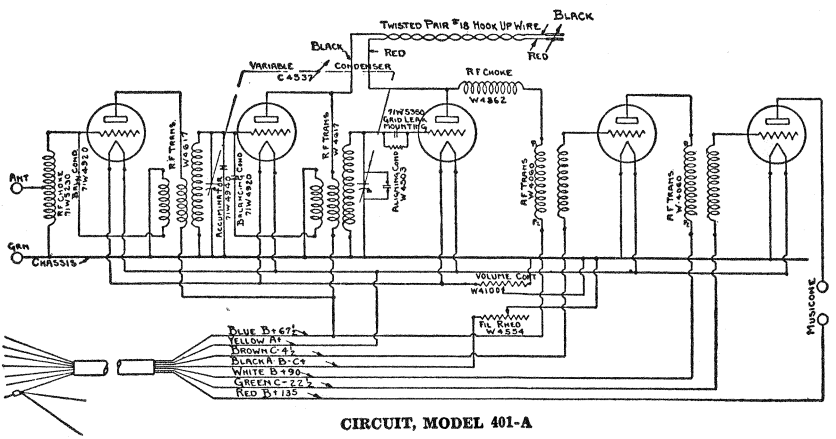
TUBE VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st R.F.	201A	5	90	0	7.0
2nd R.F.	201A	5	90	0	7.0
3rd R.F.	201A	5	90	0	7.0
Detector	201A	5	45	0	2.0
1st Audio	201A	5	90	4.5	5.0
2nd Audio	171A	5	180	40.	20.

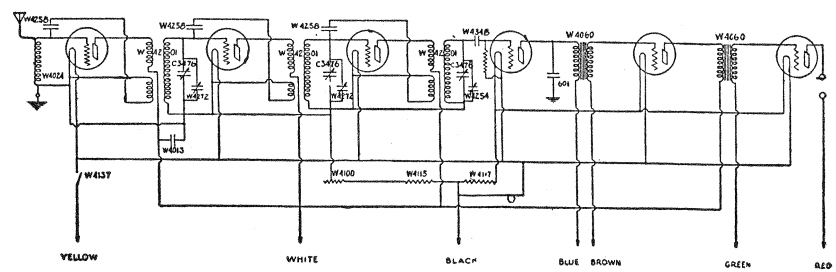
CROSLEY MODELS 401, 401A, AND 601



CIRCUIT, MODEL 401



CIRCUIT, MODEL 401-A



CIRCUIT OF MODEL 601

CROSLEY SHOWBOX — MODEL 705 D.C.

The No. 705 Showbox is an 8-tube receiver designed for operation from a 110-volt direct current line. The circuit employs three stages of neutrodyned R.F. amplification with tubes of the 201-A type, a detector and first audio stage each employing 201-A tubes, and a second and third audio with tubes of the 171-A type. The output stage uses two tubes in push-pull. Volume is controlled with a 300-ohm rheostat connected from antenna to ground, the sliding contact being brought to the ground. A type F Dynacone is used.

Since it is a D.C. set, the plug must be inserted into the socket so that the supply lines are of the proper polarity. To test the polarity, insert a 60-watt lamp in the fuse socket at the end of the power cable. Then insert the plug in the socket and observe how the lamp burns when the set is turned on. Reverse the plug and again observe the brilliance of the lamp. Use that position in which the lamp burns more dimly. Remove the lamp and return the fuse.

The filaments of all tubes are wired in series, the negative side of the line connecting the output tube bias resistances and the circuit going from there through the output tubes, the 2nd audio, 1st audio, 3rd radio, 2nd radio, 1st radio, and detector tubes. A 200-ohm resistor is placed across the filament of the last tube to obtain the correct voltage. The necessary grid biases are obtained with resistors and filament voltage drops. The output tubes are biased by the drop in a series resistor of 11 and 21 ohms. The voltage drop from the positive side of the line through the filament choke and the 95 and 45 ohm resistors to filament terminals of the various tubes supplies the necessary B voltage. The plates of all tubes are connected to the high line, but because of the voltage drop in the filaments themselves, the B voltage is different at the different tubes. The highest voltage is applied to the output tubes, and successively decreasing voltages to the tubes as they follow in line. In the filter system the R.F. chokes and the fixed condenser shunted across the line serve to cut down any high frequency interference.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stages	201-A	4.7	56	0	2.5
Detector	201-A	4.7	25	0	1.0
1st Audio	201-A	4.7	64	3	1.0
2nd Audio	171-A	4.5	66	12	12.0
3rd Audio	171-A	4.5	70	14	12.0

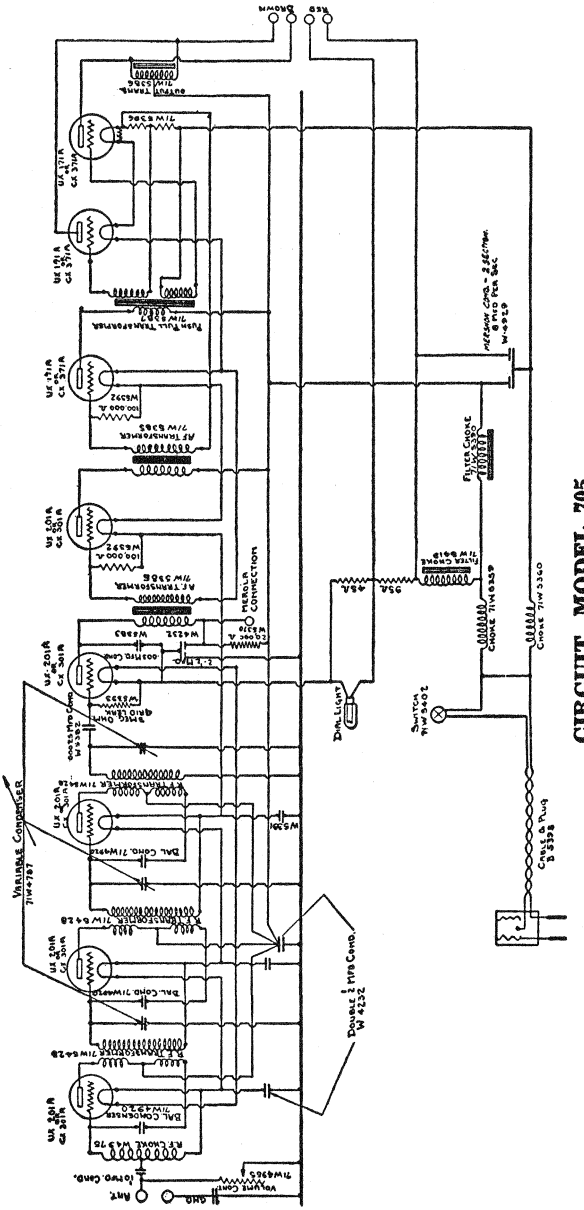
JEWELBOX — MODEL 804 A.C.

The Model 804 Jewelbox is an 8-tube receiver mounted in an all-metal table cabinet. Special wooden consoles are also used but the chassis must not be removed from the metal cabinet. It is designed for operation with the type F Dynacone. The circuit employs three stages of tuned neutrodyned R.F. stages with tubes of the 227 type, a C-bias or power detector and 1st audio stage with 227 tubes, and an output stage with two 171A tubes in push-pull. Volume is controlled by means of a variable resistor in the cathode return circuit of the three R.F. tubes. A built in power supply unit is used with a 280 full-wave rectifier, suitable filter choke and Mershon condenser.

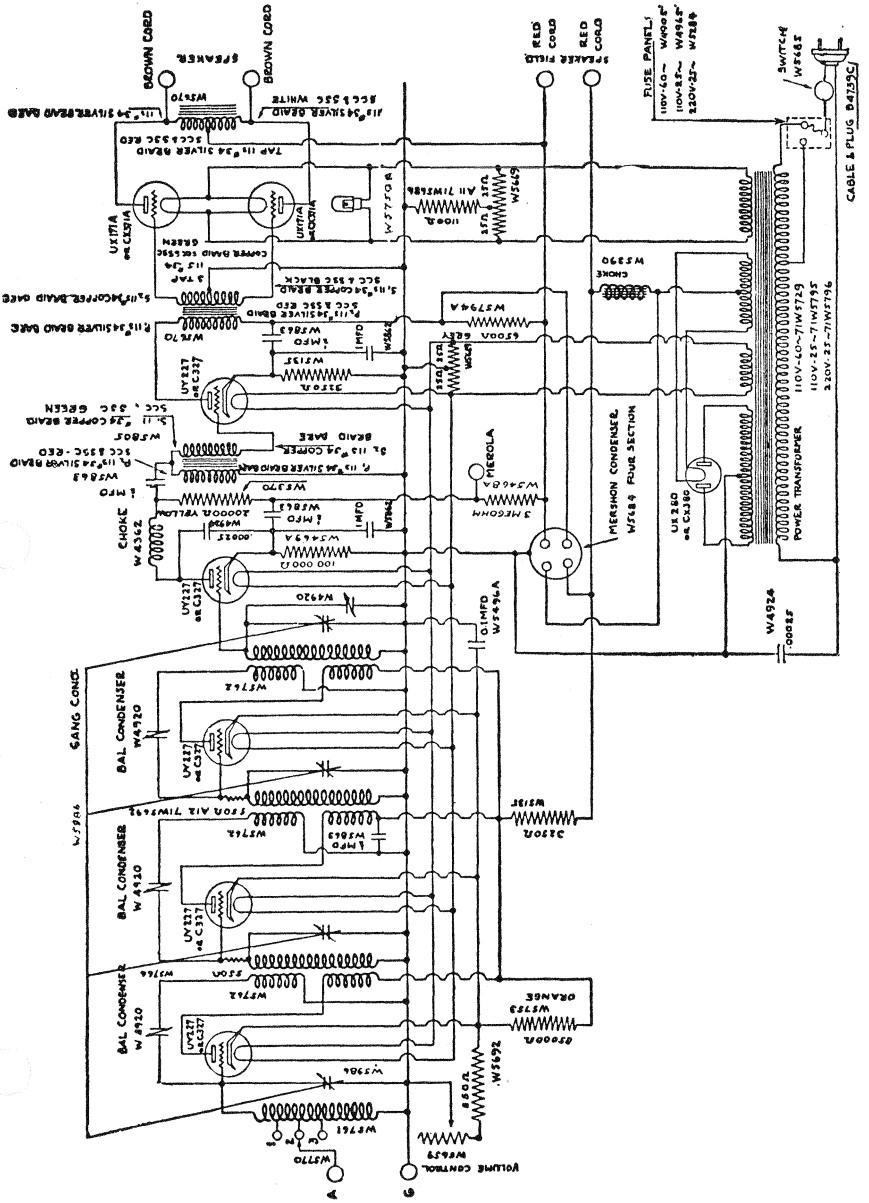
TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stage	227	2.2	175	12	5.2
Detector	227	2.2	150	22	0.2
1st Audio	227	2.2	175	12	5.2
2nd Audio	171A	5.1	180	40	18
Rectifier	280	4.8	—	—	—

CROSLEY MODEL 705 D.C.



CROSLEY MODEL 804 A.C.



CROSLEY GEMBOX AND GEMCHEST—608, 609 & 610

The Crosley Gembox No. 608 was a 6-tube (including rectifier) A.C. receiver housed in an all-metal table cabinet. The circuit has two stages of neutralized R.F. amplification with type 226 tubes, a regenerative detector with a 227 tube, a transformer coupled first audio stage with a 226 tube, and an output stage with a 171A tube. The receiver is designed for use with a type E Dynacone. Volume is controlled with a 300-ohm rheostat connected across the primary of the antenna choke, the ground lead being taken from the sliding contact. Regeneration is controlled through a small condenser connecting the plate of the detector and 2nd R.F. tubes.

A built-in power unit is used, having an input transformer, choke coil, Mershon Filter condenser, and a full-wave rectifier. On leaving the filter, the high voltage B line branches, one lead going directly to the plate of the output tube. Another leads through a 3250-ohm unit to the plates of the 1st audio and two R.F. tubes. From this same branch another tap leads through a 60,000-ohm unit to the plate of the detector. The grid of the output tube is biased through a 1650-ohm resistor connected between the grounded chassis and the midtap on a 50-ohm resistor across the filament circuit. The grids of the two R.F. and 1st audio tubes are biased similarly through a 460-ohm resistor.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st & 2nd R.F.	226	1.45	115	7	5.5
Detector	227	2.20	30	0	1.5
1st Audio	226	1.45	110	7	5.0
2nd Audio	171A	5.00	135	25	15.

The Gemchest, No. 609 and 610, employ a 7-tube (including rectifier) chassis. The 610 is housed in a metal table cabinet but special wooden consoles were designed so that the entire receiver could be put into them. Model 609 Gemchest is built into a metal console.

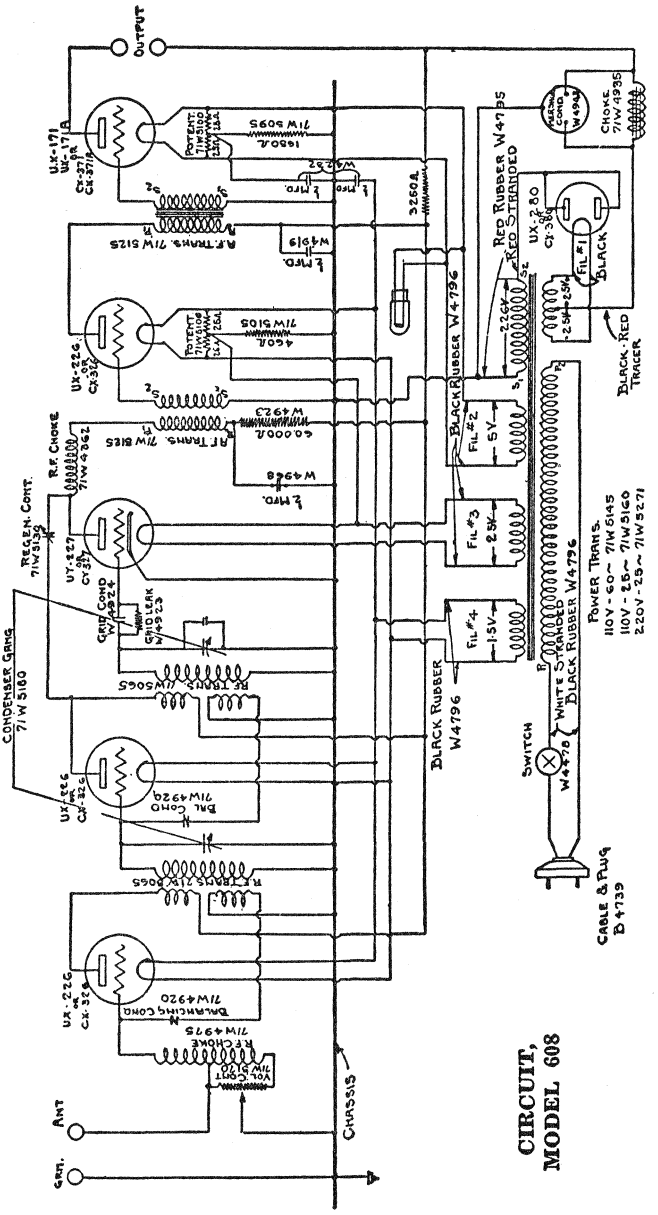
The circuit includes three stages of neutrodyned R.F. amplification with tubes of the 226 type, a detector with a 227 tube, an audio stage with a 226 tube, and an output stage with a 171A tube. Volume is controlled with a 300-ohm rheostat across a section of the antenna choke coil. A built-in power unit is used, with an input transformer that has five secondaries. A type 280 full-wave rectifier is used and a Mershon two 8-mfd. section filter condenser in connection with a suitable choke coil. The receivers are designed for operation with the Crosley Musicone or the type E Dynacone.

The plate of the power tube is connected directly to the positive side of the filter output, while the grid bias for the tube is obtained through a 2200-ohm resistor connected between the grounded chassis and the center tap on a 50-ohm filament resistor. The plates of the R.F. tubes are connected through a 3250-ohm unit to the filter output with an additional 200-ohms in series with the plate of the 2nd tube. From this R.F. line the detector plate also is fed through a 60,000-ohm unit in series. A separate 10,000-ohm unit is connected between the filter output and the 1st audio tube plate. The grids of the four 226 tubes are biased through a 625-ohm resistor.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURE

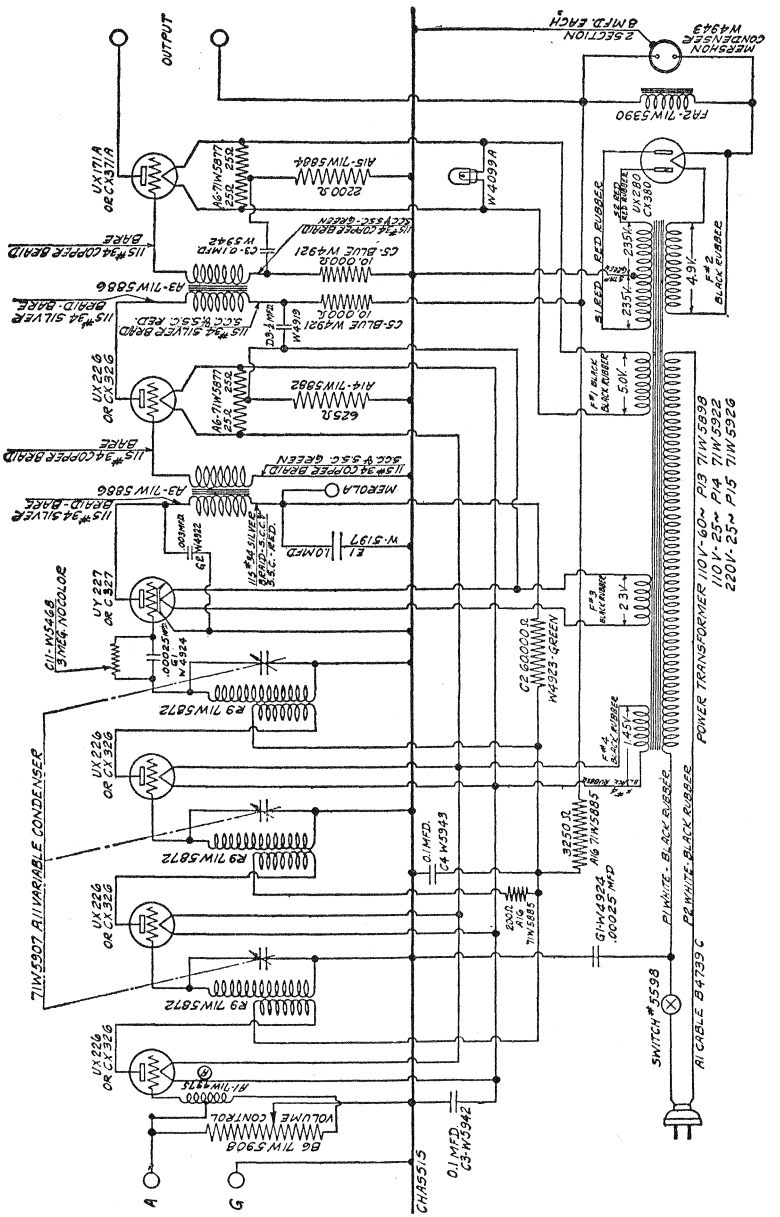
Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stages	226	1.45	160	13	5.0
Detector	227	2.30	30	0	2.5
1st Audio	226	1.45	115	13	5.0
2nd Audio	171A	5.00	175	40	20
Rectifier	280	5.00	—	—	—

CROSLEY MODEL 608 A.C.



CIRCUIT, MODEL 608

CROSLEY MODELS 609 AND 610 A.C.



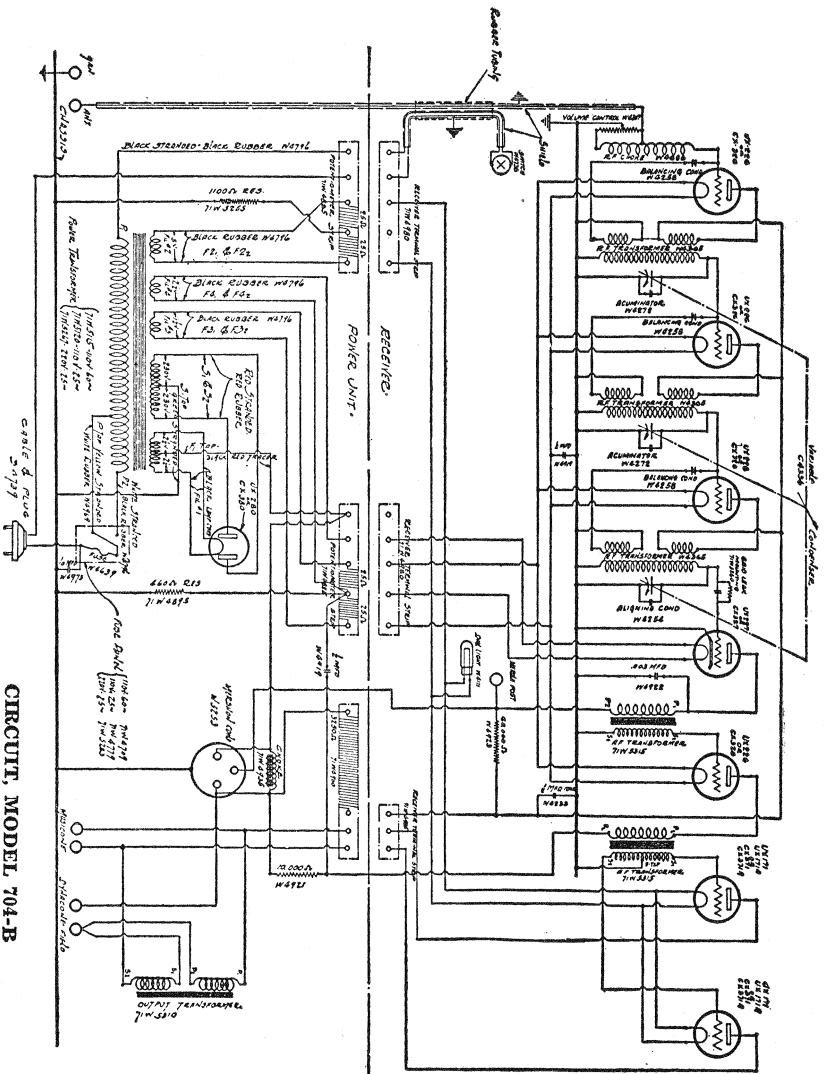
THE CROSLEY JEWELBOX — MODELS 704-A & B

The Crosley Jewelbox first appeared as a 7-tube (including rectifier) set with a circuit of the neutrodyne type. There are three stages of neutrodyned R.F. amplification with tubes of the 226 type, a detector with a 227 tube, a first audio stage with a 226 tube, and an output stage using a 171A tube. It was designed to be operated with a type E Dynacone. Small auxiliary condensers called acuminators are shunted across the first and second sections of the main tuning condenser and serve as trimmers for sharper tuning. Volume is controlled with a 300-ohm rheostat shunted across a section of the antenna choke coil. The grid leak of 3-megohms is mounted in suitable clips on the upper surface near the center of the chassis. The power supply is built in as the rear section of the receiver chassis. The D.C. output of the power converter is 220 volts, and across this output are shunted five resistors in series having the values—1525, 3475, 55, 55 and 540-ohms. The first reduces the output to 90 volts for the three R.F. and first audio stages with their —B return to the low side of the second unit. An additional 20,000-ohms connected between the first and second reduces the pressures to 45 volts for the detector, the —B return for this tube being to the low end of the third resistor. This 55-ohm unit also provides the C-bias for the four amplifier tubes. The low side of the fourth unit is the —B return for the second audio and also the —C or grid bias connection of the 1st audio tube. This provides 180-volts plate pressure for the power tube. The low end of the fifth resistor finally furnishes the 40 volts C-bias for the last tube.

Model 704-A is similar in all respects to the preceding model, except that the grid leak is built into the set and the plate supply resistors are rearranged somewhat. The following plate circuit system is used. The high voltage line after leaving the filter circuit divides into several branches. One leads through the speaker field to the plate of the output tube, while another leads through a 3250-ohm resistor to the plates of the three R.F. tubes. The plate supply for the detector tube is obtained from a branch of this R.F. circuit with an additional 60,000-ohm unit incorporated for further reducing the voltage to about 45. The plate of the first audio tube is supplied from the high voltage line through a 10,000-ohm resistor. The grid biasing voltage for the output tube is obtained with a 2200-ohm resistor connected between the grounded chassis and the center tap on a 50-ohm resistor across the filament circuit. Similarly the grid bias for the three R.F. and 1st audio tubes is obtained by means of a 460-ohm unit connected between the grounded chassis and the center tap on a 50-ohm resistor connected across the 1½-volt filament circuit.

Model 704-B is also similar to the two preceding models, except that it has two 171A tubes in push-pull in the output stage, and is designed for operation with a type F Dynacone. A slightly different arrangement of the plate supply resistors is also employed. On leaving the filter circuit, the high voltage line divides and part flows through the Dynacone field and the output transformer to the plates of the power tubes. The output transformer is built in as an integral part of the speaker circuit. Another branch of the B-line leads through a 10,000-ohm resistor to the plate of the first audio tube. A third branch goes through a 3250-ohm unit to the three R.F. tubes, and from this latter branch another lead goes through an additional 60,000-ohm unit to the plate of the detector tube. The grid bias for the two power tubes is obtained through an 1100-ohm unit connected between the grounded chassis and the center tap of a 50-ohm resistor across the filament circuit. Similarly the grid biases for the three R.F. and 1st audio tubes are obtained through a 460-ohm unit. The tube voltage values for these various 704 models are the same as listed on another page for the Crosley models 41A and 706.

CROSLEY MODEL 704 A AND B



CIRCUIT, MODEL 704-B

CROSLEY SHOWBOX—MODELS 706, 41A & 42

These Crosley models all employ a similar 8-tube (including rectifier) chassis. The model 706 Showbox first appeared in a metal table model cabinet and was designed to be operated with a type F Dynacone speaker. Model 41A was housed in a decorated metal case and used the type H Dynacoil speaker No. 242. Model 42 was housed in a wooden console cabinet with a No. 243 type H Dynacoil.

The circuit used in these receivers is of the neutrodyne type and employs three stages of neutrodyned R.F. amplification with tubes of the 226 type, a tuned detector with a 227 tube, a transformer coupled first audio stage employing a 226 tube, and a push-pull output stage with two type 171A tubes. A full wave type 280 rectifier tube is used. In the 706 model an output choke is used, but in the later two models this choke is incorporated directly in the construction of the speaker. Volume is controlled with a wire-wound rheostat connected across a portion of the antenna choke.

A built-in power supply system is used. The power input transformer has a tapped primary, the low tap for line pressures from 100 to 115 volts and the high for pressures from 110 to 125 volts. There are four secondary windings, a 1½-volt secondary for the four 226 tubes, a 2½-volt winding for the detector filament, a 5-volt winding for the filaments of the two output power tubes, a 5-volt center tapped filament winding for the rectifier filament, and a 460-volt center tapped winding for the high voltage plate supply. The filter system consists of a suitable choke coil and a 2-section Mershon condenser. In the Showbox only the plate current of the two output tubes flows through the speaker field, while in Models 41A and 42 the entire plate current flows through the field. The grids of the power tubes are biased negatively through an 1100-ohm resistor connected between the grounded chassis and the center tap on a 50-ohm resistor across the filament circuit.

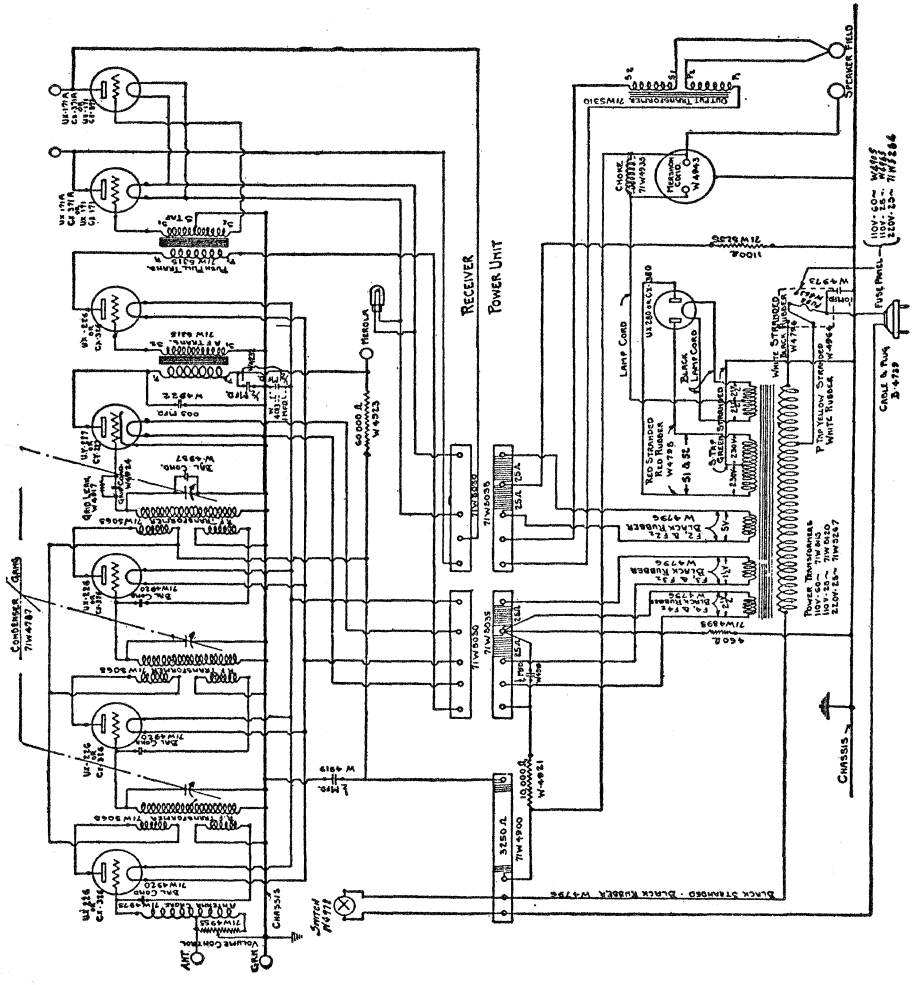
The necessary plate voltages for the various tubes are obtained through a series of resistors, which are somewhat different in the Showbox than in the other models. In the Showbox the plate circuits of the R.F. tubes are connected through a 3250-ohm unit to the high line. Another 10,000-ohm unit is connected between the high line and plate of the first audio tube. In the 41A and 42 models a 1400-ohm unit is used for the R.F. tubes and a 6500-ohm unit for the 1st audio. In all models a 60,000-ohm unit is used between the detector plate and the positive B line of the R.F. tubes. The grid circuits of the R.F. and first audio tubes are grounded to the chassis, and the ground in turn is connected to the midpoint of a 50-ohm potentiometer across the filaments of these tubes through a 460-ohm resistor unit which supplies the required biasing voltage.

These receivers will perform best with an outdoor aerial from 50 to 60 feet long, but indoor aerials can also be used. They can be operated without an aerial by connecting the ground wire to the aerial post on the set. On account of the Mershon filter condenser that is used in the power unit it may take several minutes before the receiver will operate most efficiently when first installed or after it has been standing idle for several weeks. The tuning condensers can be aligned by means of a small adjustable condenser shunted across the detector section of the condenser. The speaker field must never be opened while the set is in operation.

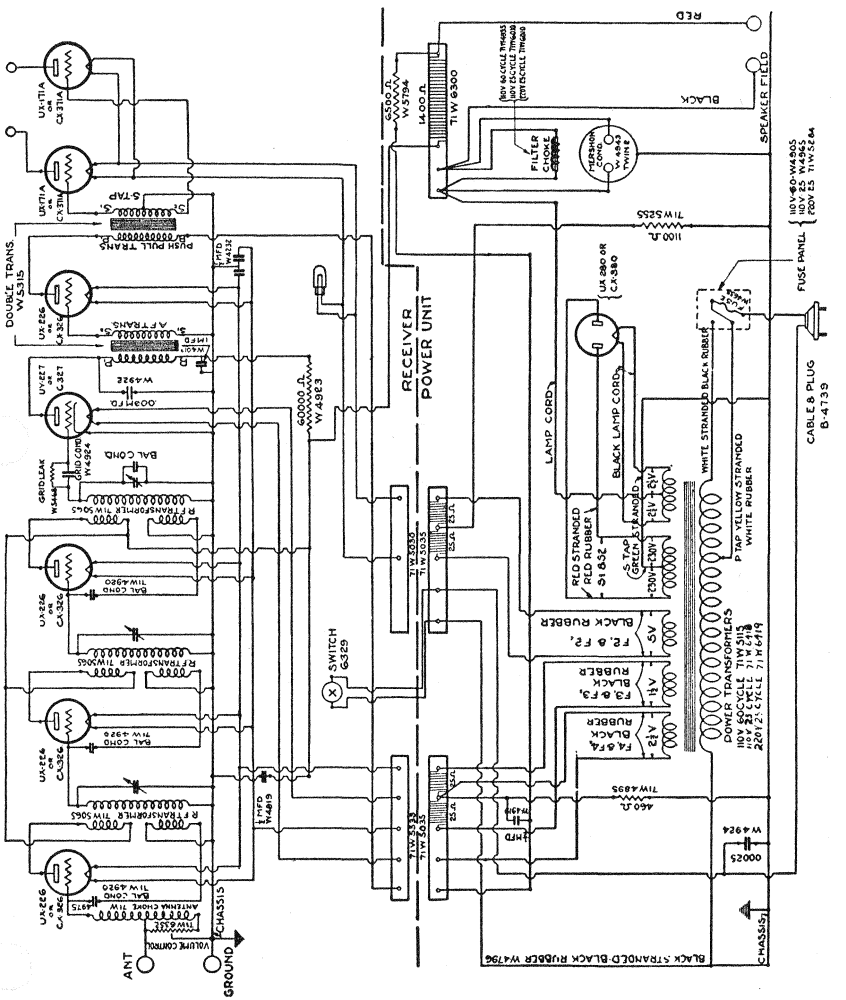
TUBE VOLTAGES AT 115-VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st, 2nd & 3rd R.F. Stages	226	1.5	150	11	6.5
Detector	227	2.25	30	0	2.2
1st Audio	226	1.5	120	9	6.2
2nd Audio	171A	5.0	170	37.5	20.0

CROSLEY MODEL 706



CROSLEY MODELS 41A AND 42A



CROSLEY 30S, 31S 33S AND 34S

The Crosley models bearing the numbers 30S, 31S, 33S or 34S all use a similar 7-tube (including rectifier) A.C. screen grid chassis and differ only in the style of cabinet in which they are mounted. The circuit used in these receivers consists of two stages of tuned radio frequency amplification utilizing 224 type screen grid tubes, a detector and first audio stage with 227 type tubes, and a push-pull output stage with two type 245 power tubes.

The tuning system consists of an antenna coupler and two R.F. transformers all tuned with a 3-gang condenser. The R.F. transformers are of special design and introduce capacity coupling between the stages in addition to the usual inductive coupling. The effect of this capacity coupling is to increase the transfer of energy at the higher frequencies and thus provide equal energy transference at all frequencies. A range control is provided which varies the energy transfer from the antenna circuit to the grid of the first R.F. tube. In the last position the antenna is disconnected entirely and the receiver is dependent upon the pick-up in the ground circuit. Volume is controlled by means of a 32,500-ohm potentiometer which regulates the positive potential applied to the screen grids, and the bias potential applied to the control grids of the two R.F. tubes.

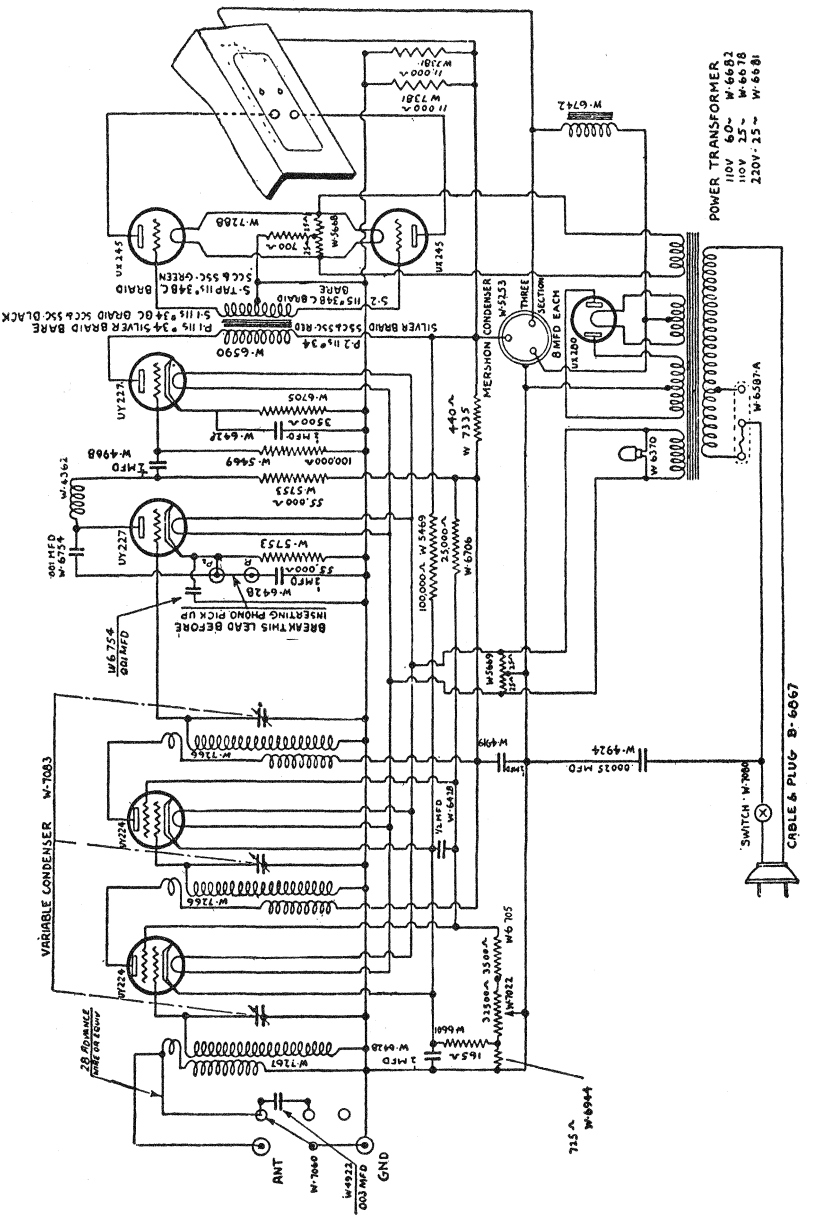
The detector is of the grid bias or plate rectification type and is coupled to the first audio stage through a 55,000-ohm resistor and ½-mfd. coupling condenser. A 100,000-ohm grid leak is used. The grid of this audio tube is biased by means of a 3500-ohm cathode resistor shunted by a .5-mfd. bypass condenser. It is coupled to the two 245 tubes through a standard input transformer, while the output transformer is built into the loud speaker.

The power transformer has a tapped primary and four secondary windings. One secondary supplies the filament current to the R.F., detcetor, and 1st audio tubes, while another supplies current to the two 245 tubes. The other two windings furnish the rectifier filament and plate supply. The negative plate return lead is grounded to the metal chassis. The outgoing positive lead is connected through a choke coil to a speaker terminal on the chassis. In the speaker the circuit divides, part of the current flowing through the output transformer primary to the plates of the power tubes, and the other part through the speaker field and back to the chassis. A Mershon filter condenser is used in connection with the choke coil.

From the positive speaker terminal on the chassis one branch leads to the plate of the first audio tube. Another passes through a 440-ohm resistance to the R.F. plates and through an additional 55,000-ohm resistance to the detector plate. Since the speaker field current is greater than the combined plate currents of the R.F., detector, and first A.F. tubes, this additional current is carried to the grounded chassis through a 5500-ohm shunt resistor (or two 11,000-ohm units in parallel). A third branch of the circuit leads from the 440-ohm resistance through a 25,000-ohm unit to the screen grids of the R.F. tubes. This branch is further grounded through a 3500-ohm unit in series with the 32,500-ohm potentiometer which serves as the volume control.

A 700-ohm biasing resistance is used for the two 245-power tubes, while the control grids of the two R.F. tubes are biased by means of a 165-ohm resistor, a 725-ohm resistor, and the 32,500-ohm potentiometer. This volume control potentiometer simultaneously varies the positive potential of the screen grids and the negative bias on the control grids. The biasing resistor for the output tubes is connected to the filaments of these tubes through the middle tap of a 50-ohm resistor shunted across the filament leads. A similar resistor with its middle tap grounded, is shunted across the filament leads of the first four tubes.

CROSLEY MODELS 30S, 31S, 33S, AND 34S



CROSLEY MODELS 40S, 41S, 42S, AND 82S

These four Crosley models use an 8-tube (including rectifier) screen grid A.C. receiver. The circuit includes three stages of tuned R.F. amplification with tubes of the 224 type, an untuned power detector with a type 227 tube, a resistance coupled first audio stage with a 227 tube, and a transformer coupled push-pull output stage with two 245 power tubes. A built-in power supply system is used.

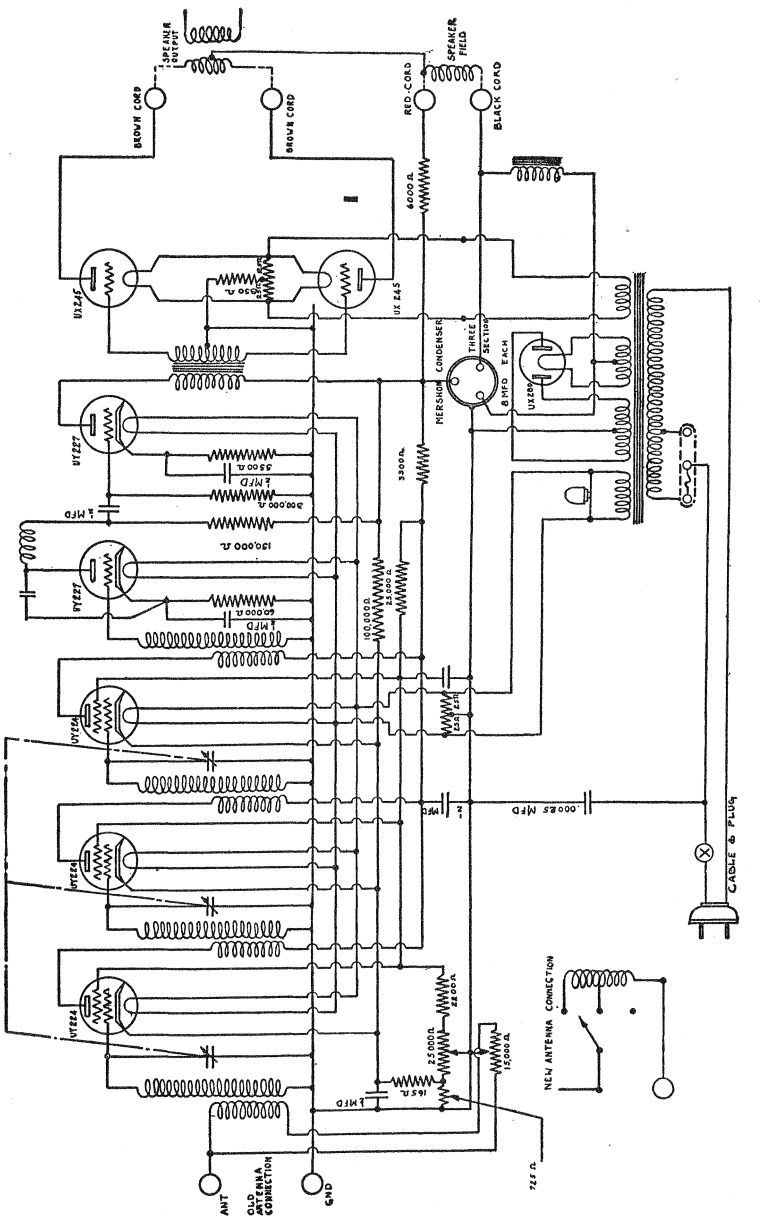
In receivers of serial numbers with the prefix GC, GCA, GCB or GCC the volume control consists of a double rheostat with one section across the antenna primary and the other in the screen grid circuit to regulate the screen grid voltage. All other serial numbers use but one rheostat to control the screen grid potential, but are also equipped with a "range control" operated by rotating the switch lever to regulate the amount of energy delivered from the antenna to the first R.F. stage. In this latter case the primary of the first R.F. transformer is omitted and a single coil used connected directly into the grid circuit of the first R.F. tube. This new antenna connection is illustrated in the circuit diagram. The earlier chasses used type J 85-milliampere Dynacoil 4-lead speakers, while the later models use the type M 45-milliampere Dynacoil with plug connections fitting sockets on the chasses.

The power input transformer has a tapped primary, the low tap for line pressures from 100 to 115 volts and the high tap for pressures from 110 to 125 volts. The filaments of the first five tubes are connected in parallel to a 2½-volt secondary, across which is also shunted the dial light and a 50-ohm potentiometer with its center tap grounded to the chassis. The filaments of the 245-tubes are on another secondary and also shunted by a 50-ohm potentiometer but with its midtap grounded through an 850-ohm biasing resistor. The filter output voltage is then supplied to the midtap on the output transformer primary for the plates of the power tubes. Another branch leads through a 6000-ohm resistor to the plate of the first audio tube, and further through a 150,000-ohm unit to the plate of the detector tube. A tap also leads through a 3500-ohm unit to the plates of the R.F. tubes. From the low side of this resistor the voltage is further reduced by a 25,000-ohm resistor to the proper value for the screen grids.

The necessary biasing voltages are also obtained by means of various resistors. A 3500-ohm cathode resistor shunted by a ½-mfd. condenser biases the grid of the first audio tube. A 60,000-ohm resistor also shunted by a ½-mfd. condenser is used in the cathode circuit of the detector tube. The control grid bias for the screen grid tubes is obtained through a resistance connected between their cathode circuits and the grounded chassis. In this circuit there is a bleeder current as well as the normal tube current flowing in the biasing resistors. The bleeder current is supplied from the high line through a 100,000-ohm resistance.

Several other changes have been made in these chasses from time to time, including the following items. The "on-off" switch which was of the rotary type operated by turning the knob clockwise was replaced with a toggle switch operated by moving the knob out or in, the same knob also operating the range control by a rotary motion. In the earlier types a 1-ampere cartridge type fuse was used reached through a hole in the bottom plate, but the later models use a 2-ampere fuse and have a cover over the bottom plate hole. No phonograph pick-up terminals were provided at first, but later these were added and connected directly to the detector grid circuit. Some models also have a .001-mfd. condenser and choke added into the pick-up lead. In some models the 850-ohm output biasing resistor is replaced by one of 700-ohms. The .00025-mfd. grounding condenser which was at first connected on the line side of the fuse, was later changed so as to connect the line to the receiver side of the fuse.

CROSLEY MODELS 40S, 41S, 42S, AND 82S



CROSLEY COMPANIONSHIP SERIES — CHASSIS 70S

Buddy, Chum, Playmate and Comrade

The Crosley Companionship series includes four very low-boy models called the Buddy, Chum, Playmate, and Comrade. The Playmate has a No. 30S 7-tube screen grid chassis housed in a wooden console, while the Comrade has a No. 40S 8-tube screen grid chassis mounted in a similar console. Technical service data on these chasses will be found on other pages in this manual. The Buddy and Chum both have a new 6-tube screen grid chassis. The Buddy is housed in a small metal cabinet with detachable legs, while the Chum is housed in a small wooden console.

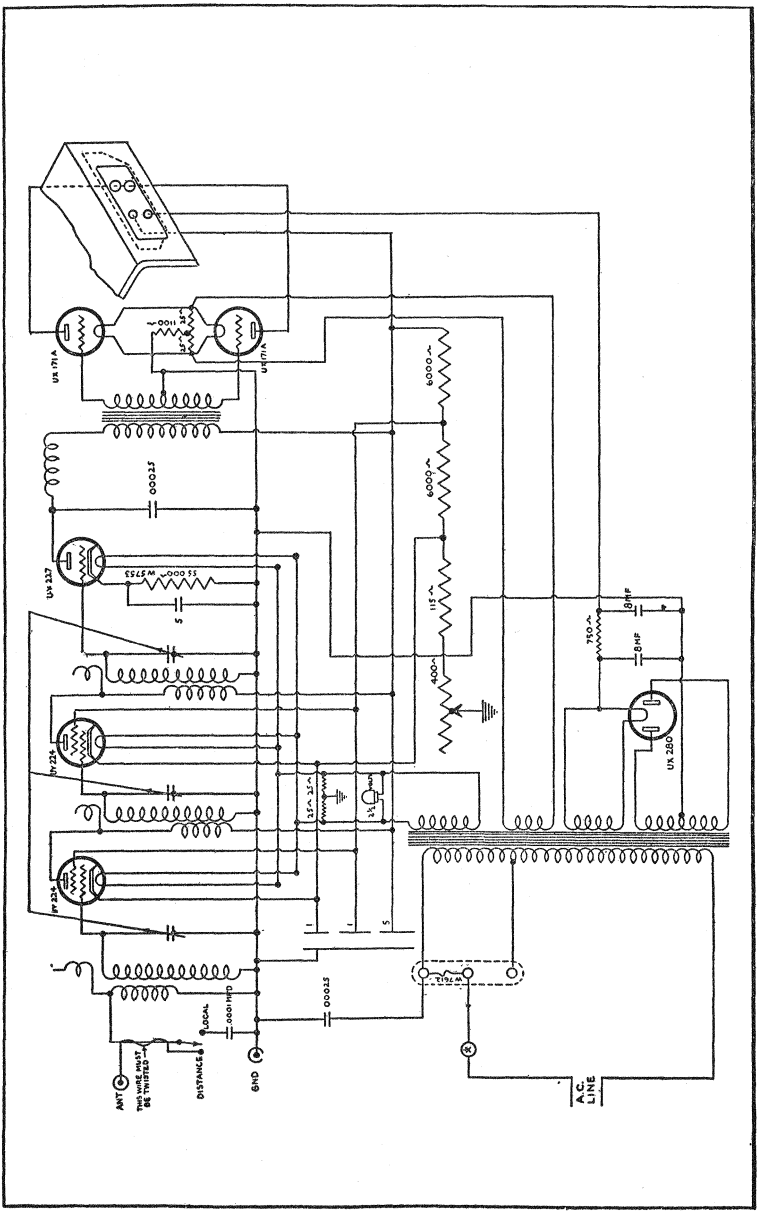
The Buddy and Chum, use a 6-tube chassis employing two stages of tuned R.F. amplification with tubes of the 224 type, a tuned grid bias or power detector with a 227 tube, and a single audio stage with two type 171A tubes in push-pull. The tuning system consists of an antenna coupler and two R.F. transformers, all tuned with a 3-gang condenser. Each section of this condenser is provided with aligning trimmers. An interesting feature of the three R.F. transformers is the use of several free end turns which provide a slight amount of capacity coupling in order to secure a more uniform amplification throughout the entire frequency range. A toggle type local-distance switch is provided to by-pass a part of the signal current around the primary of the first transformer when it is thrown into the local position. Plate rectification is secured in the detector through a 55,000-ohm cathode biasing resistor which is by-passed by a .5-mfd. condenser. The plate circuit of the detector leads through a R.F. choke directly into the input transformer of the push-pull stage. The grids of the two power tubes are biased through an 1100-ohm resistor connected between the grounded chassis and the center tap on a 50-ohm filament resistor.

The built-in power supply system consists of a transformer with the necessary filament and high voltage secondaries, a 750-ohm filter resistor, and a Mershon filter condenser with two 8-mfd. sections. The high-voltage line leads through the speaker armature coils where a tap is taken off for the plates of the two power tubes. On leaving the speaker, the line divides and one branch leads directly to the plates of the detector and two R.F. tubes. The other branch leads through a 4-section series resistor to the ground. The first is a 6000-ohm unit and reduces the voltage as it is needed for the screen grids of the two R.F. tubes. The second is also 6000-ohms and provides the voltage drop for the cathodes of these tubes, while the third is a 115-ohm unit followed by a 400-ohm rheostat, the latter serving as a volume control by regulating the potential of the cathodes. The grids of the R.F. tubes are returned through the R.F. transformer secondaries to the grounded chassis. They are biased through the previously mentioned 115-ohm resistor and volume control rheostat.

TUBE VOLTAGES AT 115 VOLTS LINE PRESSURS

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.	Screen Volts
1st R.F.	224	2.2	180	2.5	2.6	82.0
2nd R.F.	224	2.2	180	2.5	2.6	82.0
Detector	227	2.2	150	20.0	.25	—
Audio	171A	4.6	180	35	17	—
Andio	171A	4.6	180	35	17	—
Rectifier	280	4.6	—	—	28.5	—

CROSLEY BUDDY AND CHUM



CROSLEY MODELS 20, 21 AND 22

The Crosley Models 20, 21 and 22 are six-tube screen-grid chasses designed for operation from a 6-volt storage battery. The circuit employs three tuned Radio frequency stages with tubes of the 222 type, an untuned detector and first audio stage using 201A or 112A type tubes in either or both sockets, and an output stage using a 171A type power tube. The radio and audio frequency stages are transformer coupled, while the detector is coupled to the third R.F. stage through a suitable choke coil. In the earlier models of these receivers a grid leak type detector was used, but in the later models a "C-bias" or power detector was substituted with a choke instead of a resistor in the grid circuit. The volume control consists of a rheostat in series with a fixed resistor, the volume being regulated by varying the filament supply and C-bias of the R.F. tubes. A 6-volt dial light is shunted across the filament leads, and a switch is provided in the A plus line for turning the power on or off.

Several changes were made in the chasses since they were first introduced. The original chasses were built for use with the type E Dynacone; but when the type C Dynacone with separately excited field coils came out, two terminals (red and black) were added to the chasses for supplying the field of the speaker with current directly from the storage battery or A supply. Also, for a short time the yellow and black filament terminals were connected to the points shown by the dotted lines marked 2Y and 2B in the circuit diagram. And thirdly, in the later chasses the 3-megohm resistor in the detector grid circuit is replaced by an A-2 radio frequency choke, the 0.85-ohm resistor is moved to the negative filament lead, and the detector grid return is connected to the negative side of the 0.85-ohm resistor. These changes are marked "3" in the circuit diagram.

Chasses having four speaker terminals are for use with Dynacone speaker Type C. Those with two speaker terminals are for use with the type E Dynacone. For operating the receiver the following batteries are needed: for the filament supply a 6-volt storage battery is required preferably one with a capacity of 100 to 120 ampere-hours, while for the B-supply four 45-volt B-batteries of the heavy duty type are needed. The C-supply requires two 22½-volt and one 4½-volt battery. A cable with colored leads is provided for making connections to the batteries. The color code and the normal operating voltages that should be applied to the various leads are as follows:

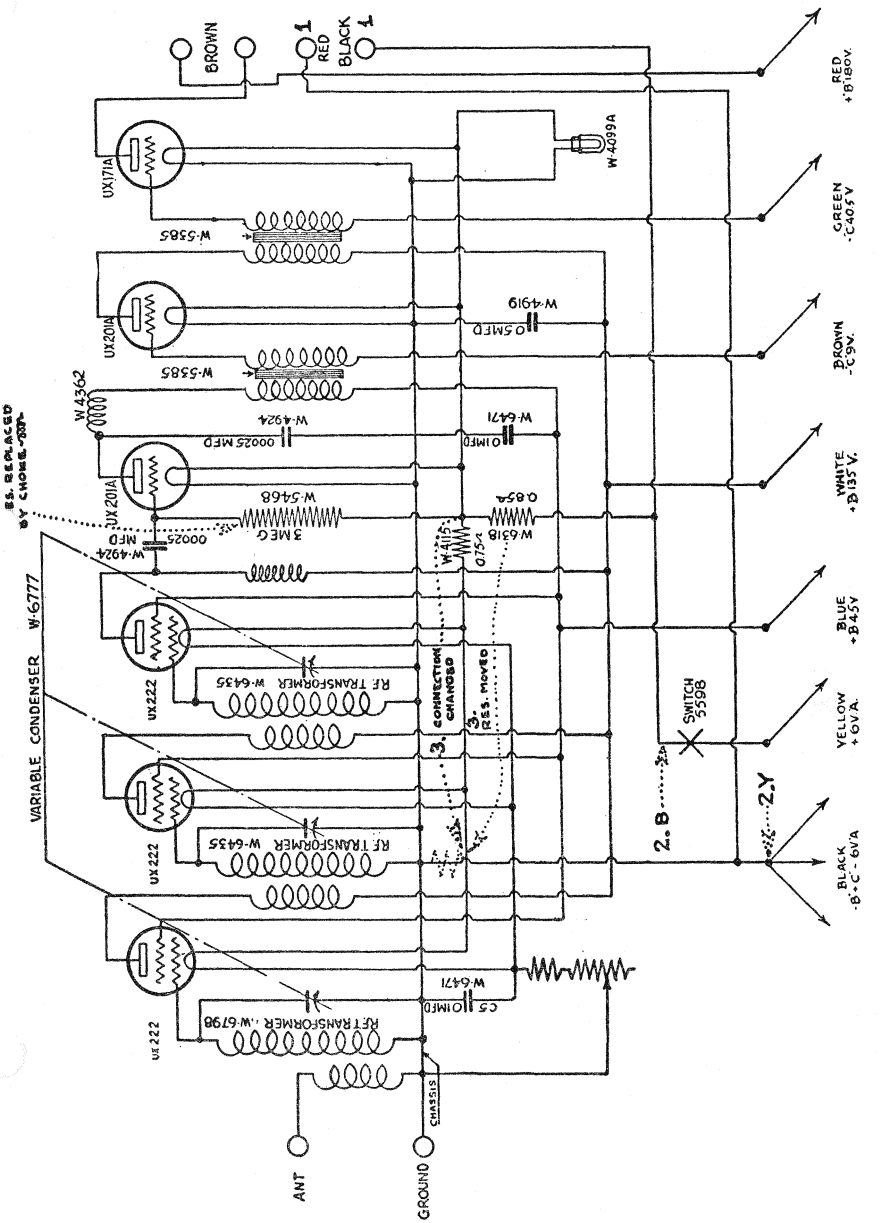
Red	B+ ..... 180 Volts	Yellow	A+ ..... 6 Volts
White	B+ ..... 135 Volts	Brown	C— ..... —9 Volts
Blue	B+ ..... 45 Volts	Green	C— ..... —43½ Volts
Black	A—, B—, C+ ..... 0 Volts		

If it is desired to use but three B-batteries, this can be done with reduced volume by using the following voltages:

Red ..... 135 volts instead of 180 volts
Green ..... —28 volts instead of —43.5 volts

The voltages at the various sockets should be practically the same as those applied to the battery cable, provided that all tubes are removed so that there is no load on the batteries. The speaker remains connected. The filament voltages should be measured between the two contacts of each socket. All other voltages should be measured between the two contacts of each socket. All other voltages should be measured between the plate or grid contact and the negative filament contact of the socket. Use a D.C. voltmeter having a resistance of at least 1000 ohms per volt.

CROSLEY MODELS 20, 21 AND 22



CROSLEY MODEL 26

The Crosley Model 26 is a 7-tube battery operated chassis marketed in the fall of 1930 and supplied in two types of console cabinets known as the Crony and Partner. The circuit includes three stages of tuned R.F. amplification with type 222 screen grid tubes, a grid leak detector with a type 201A tube, a resistance coupled first audio stage utilizing a 201A or a 112A tube, and a push-pull output stage with two 112A tubes. The antenna is coupled to the 1st R.F. stage through an air core auto-transformer, which together with the next two R.F. transformers is tuned with a 3-gang condenser. Each condenser section is equipped with a small trimmer or aligning condenser. The detector input is untuned. A local-distance switch is also provided. When in the distance position it connects the antenna directly to the coupling coil, but in the local position the connection is made through capacity coupling only. A 100,000-ohm plate resistor and 300,000-ohm grid leak are used in connection with a 0.1-mfd. condenser in the resistance coupler between the detector and 1st audio stage.

There are two resistors in the "A" battery circuit, a ballast resistor of 0.55 to 0.60 ohms in the positive side to reduce the voltage to the proper value, and a resistor of 4.75 to 5.25 ohms in the negative return from the R.F. tubes to supply the proper voltage to the filaments of the screen grid tubes. The power switch is also in the negative line. Only a single B-pressure of 180 volts is supplied to the receiver, and the required plate voltages, biasing and screen grid voltages are provided through resistors connected into the circuit at appropriate places. The negative "B" line is connected to the chassis through a 350 ohm resistor with the grids of the 1st audio and output tubes connected to its negative end so that the voltage drop across it provides the necessary C-bias. The drop of 1½-volts across the previously mentioned 5.25 ohm resistor supplies the necessary grid bias for the R.F. tubes, for it maintains the filaments 1½-volts positive with respect to the chassis while the control grids of the tubes are at chassis potential.

A branch of the positive "B" circuit leads through the speaker armature to the plates of the output tubes. The armature coils are connected so that the D.C. component of the plate current is balanced out, and only the signal current is effective in moving the armature. Another branch goes through a 4400-ohm resistor to the plate circuits of the 1st audio and R.F. tubes, and through an additional 150,000-ohm resistor to the plate circuit of the detector tube. A sub-branch from the negative end of this 4400-ohm unit leads through a 60,000-ohm resistor and 150,000-ohm volume control, carrying bleeder current to the chassis. The screen grids of the R.F. tubes are connected to the variable contact on this volume control, and are maintained positive by the drop caused by the bleeder current through it. Current for energizing the speaker field is supplied by the "A" battery, the field connection being taken off ahead of the ballast resistor as indicated in the circuit diagram.

TUBE VOLTAGE LIMITS

Filament Voltages

R.F. Tubes	2.4 to 2.7
Det. & 1st A.F.	4.3 to 4.8
Output stage	4.3 to 4.8

Plate Voltages

R.F. & 1st A.F.	120 to 130
Detector	110 to 120
Output tubes	150 to 160

Control Grid Voltages

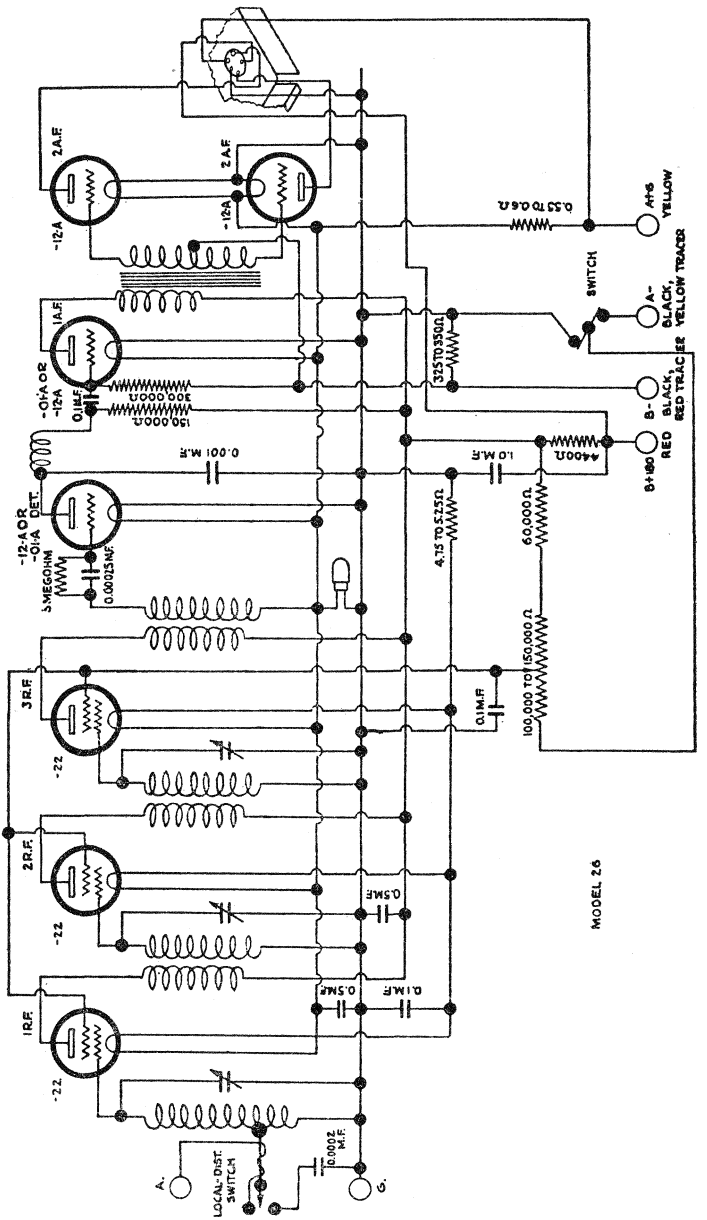
R.F. Tubes	1.6 to 2.0
Detector	4.3 to 4.6
1st A.F.	4.3 to 4.6
Output tubes	4.3 to 4.6

Screen Grid Voltages

R.F. tubes	48 to 55

The above voltages are to be measured with the speaker connected, and with a fully charged "A" battery and fresh "B" batteries.

CROSLEY MODEL 26



CROSLEY MODELS 53, 54 AND 57

The Crosley Models 53, 54 and 57 are A.C. screen grid chasses that were marketed in the fall of 1930 and were supplied in three different cabinets known as the Buddy, Pal and Mate. The three chasses are very similar electrically and differ chiefly in their mechanical construction. Model 54 is built more compact for use in the Buddy or mantle-type cabinet. Resistance coupling is used between the detector and output audio stage, with a 150,000-ohm plate resistor, a 1-megohm grid leak and a 0.1-mfd. blocking condenser.

In the high-voltage filter system a single choke and a two 8-mfd section Mershon condenser are used. The circuit divides into three branches, one going through the speaker field to the plate of the output tube, another through a 150,000-ohm resistor to the plate circuit of the detector tube, and the third through a 10,000-ohm resistor to the plate circuits of the R.F. tubes. A sub-branch from the R.F. plate supply circuit leads through a second 10,000-ohm resistor to the screen grids of the first three tubes. A third 10,000-ohm unit carries the bleeder current from the second resistor to the ground. The grid of the power tube is biased through a 1650-ohm resistor connected between the ground and the center tap on a 50-ohm filament resistor. The cathodes of the R.F. tubes are biased through a 440-ohm resistor in series with a 20,000-ohm unit shunted by a 25,000-ohm volume control. This arrangement prevents the bias from becoming too high and at the same time permits sufficient resistance to be connected into the antenna circuit for cutting down the signal volume. A 1-megohm resistor shunted by a 0.1-mfd. condenser is connected into the detector input circuit to prevent the tube from overloading. Two terminals marked PH are provided for pick-up connections. These are joined by a wire which must be cut if a pick-up is to be used, and the pick-up terminals connected to them. Also, a S.P.D.T. switch is connected to the terminals with short leads. When operating the pick-up, open the switch and detune the receiver. To operate the receiver close the switch and tune in as usual. If the pick-up and switch are later disconnected, a wire must be connected between the PH terminals.

Model 54 differs in that the PH terminals are between the R.F. transformer and the 0.1 mfd condenser instead of between this condenser and ground. The triple unit condenser near the center of the diagram has these values from right to left, 0.1, 0.1, 0.5 mfd instead of those shown. Also, no dial light is used. Model 57 differs in that an additional 0.25 mfd condenser is shunted across the filter choke. The primary of the speaker output transformer is connected in the position in which the speaker field is shown in the diagram. Instead of being connected to the 1650-ohm resistor through a condenser, the bottom speaker terminal is connected to ground. The speaker field is connected from this grounded terminal to the middle speaker terminal in the diagram, so that current from the positive "B" circuit flows through the speaker field to ground. A fixed condenser is shunted across the 1650 ohm biasing resistor.

TUBE VOLTAGE LIMITS

Filament Voltages

R.F. & Detector tubes	2.1 to 2.3
A.F. tube	2.2 to 2.4
Rectifier	4.1 to 4.3

Plate Voltages

R.F. tubes	160 to 180
Detector	215 to 245
A.F. tube	230 to 260
Rectifier	340 to 370

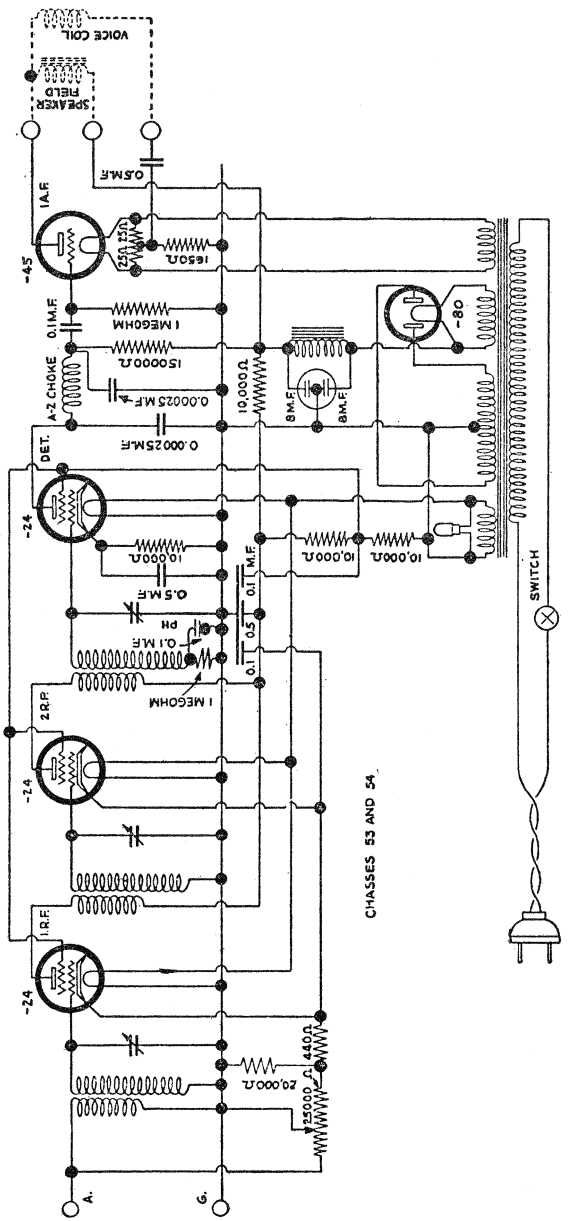
Control Grid Voltages

R.F. tubes	3.1 to 3.5
Detector	9.0 to 10.0
A.F. tube	45.0 to 50.0

Screen Grid Voltages

R.F. and detector	85 to 95
R.F. tubes	3.2
Detector	3.5
A.F. tube	33.5

CROSLEY MODELS 53, 54 AND 57



CROSLEY MODELS 60S, 61S, 62S AND 63S

The Crosley Models 60S, 61S, 62S and 63S are 8-tube receivers designed for operation from a 110-volt direct current line. All four models employ the same chassis, and are merely mounted in different types of cabinets. The circuit consists of three stages of screen grid R.F. amplification with tubes of the 222 type, a screen grid detector with a type 222 tube, a first audio stage with two 112A tubes in parallel, and a push-pull output stage using two type 171A tubes. Tuning is accomplished with three ganged condensers in the grid circuits of the R.F. stages, the detector circuit being untuned. The antenna circuit is coupled to the first R.F. stage through a tuned auto transformer. Resistance coupling is used between the detector and the first audio stage with its two 112A tubes, while a push-pull input transformer is used between the first and second stages.

Volume is controlled by means of a high resistance potentiometer which controls the voltage applied to the screen grids of the three R.F. tubes. This volume control in series with a 10,000-ohm fixed resistor is connected across the input line, and the bleeder current in flowing through the potentiometer produces the voltage that is used for the screen grids. A range control is also provided, and consists of a 3-point switch that controls the amount of energy transferred from the antenna circuit to the first R.F. stage.

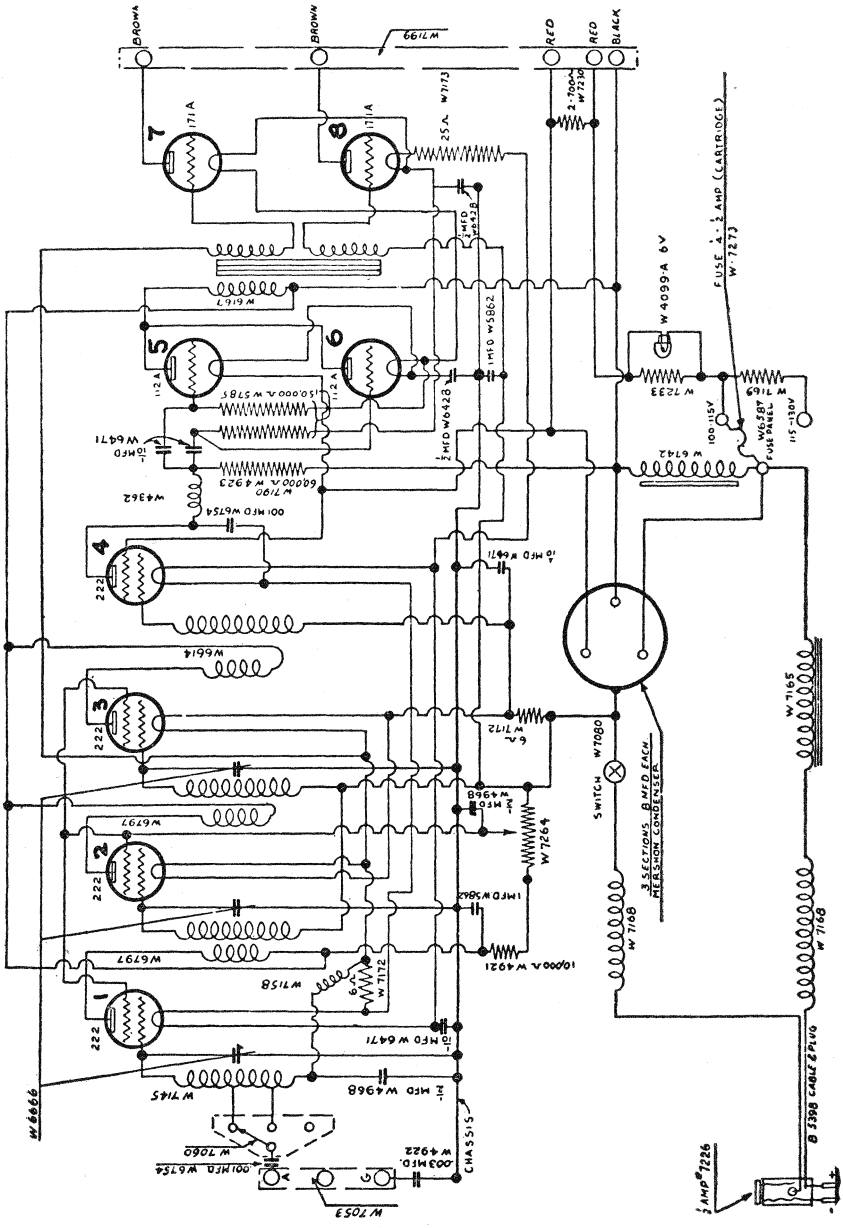
The filament circuit is a rather novel arrangement. Two line chokes are used, one for keeping high frequency disturbances out of the receivers, and the other an iron core choke for filtering out any current ripples. The plate and filament circuits then divide, the filament circuit leading through a ½-ampere fuse and 45-ohm fixed resistor (across which the 6-volt pilot light is connected) and then passing through the field coil of the type L Dynacoil speaker in parallel with which are two 700-ohm resistors. The current then flows through the filaments of the audio tubes 5, 6, 7, and 8 successively and through a 25-ohm resistor. It now divides and one-half flows through the first R.F. tube (No. 1) and the other half through the detector (No. 4). The two branch currents then unite and flow through a 6-ohm biasing resistor, only to divide again through the filaments of the two R.F. tubes (No. 2 and 3). On coming together they flow through another 6-ohm resistor to the negative side of the line.

The plate circuit filter consists of a suitable iron core choke and a 3-section Mershon electrolytic condenser. The plate current to the two output tubes is supplied through the black speaker lead which is connected to the midtap on the output transformer built into the speaker. The remainder of the plate circuit can easily be traced from the circuit diagram. The necessary C biases for the different tubes are obtained by summing up the voltage drops in the filaments and the various series resistors. These can easily be checked by tracing the circuit and observing where the grid return for each tube makes contact with the filament circuit.

VOLTAGE LIMITS

Filament Voltages		**Control Grid Voltages**	
R.F. & Detector Tubes	2.6 to 3.4	R.F. tubes	1.4 to 2.3
All A.F. tubes	4.2 to 5.5	Detector tube	4.0 to 5.5
Plate Voltages		112A A.F. tubes	4.2 to 5.5
1st R.F. tube	90 to 100	Output tubes	14.0 to 19.0
2nd R.F. tube	93 to 103	**Screen Grid Voltages**	
3rd R.F. tube	95 to 105	1st R.F. tube	47 to 67
Detector tube	64 to 74	2nd and 3rd R.F. tubes	50 to 70
A.F. tube No. 5	66 to 76	Detector	14 to 34
A.F. tube No. 6	72 to 82		
Output tube, No. 7	77 to 87		
Output tube, No. 8	81 to 91		

CROSLEY MODELS 60S, 61S, 62S AND 63S



CROSLEY MODEL 77

The Crosley Model 77 chassis was introduced in the fall of 1930 and was used in two console models known as the Director and Arbiter. It is a 7-tube A.C. chassis and employs two stages of tuned R.F. amplification with tubes of the 224 type, a tuned grid-bias detector with a type 224 tube, a resistance-coupled first audio stage with a type 227 tube, and a push-pull output stage with two type 245 tubes. A type 280 full wave rectifier is used in the power supply. A special feature of the R.F. transformers is the use of a few-turn free-end secondary to produce sufficient capacity coupling in addition to the inductive coupling so that uniform amplification is had over the entire wave length range. Volume is controlled by means of a 300,000-ohm variable resistance in the grid circuit of tht first audio tube. A local-distance switch marked L and D in the circuit diagram is also provided for regulating the amount of energy transferred from the antenna to the first R.F. stage.

The power supply system has an input transformer with a tapped primary and four secondaries consisting of three filament windings and a high voltage plate supply winding. With the fuse in the "Low" position the receiver is adapted to operation from 100 to 115 volt circuits, and in the "High" position for operation from 115 to 130 volt circuits. From the center tap on the rectifier filament winding the positive side of the high-voltage plate supply circuit passes through the filter system consisting of a choke coil and Mershon condenser to the field coil of the loud speaker. Here the circuit divides and one branch goes directly to the midtap on the primary of the output transformer which is built into the speaker. The other branch goes through the speaker field coil and then to the plate circuits of the other tubes and through the bleeder resistors to the negative side of the line which is grounded to the chassis.

The screen grid of the detector tube is connected to the plate supply circuit through a 1-megohm resistor, which reduces the voltage to the required value. The screen grids of the R.F. tubes are connected to the plate supply circuit through 10,000 and 1750-ohm resistors shown in the circuit at the left of the filter system. After passing through the 1750 resistor the plate supply circuit is grounded through a 2000-ohm and 225-ohm resistor connected in series, and the cathode of the first audio tube is connected to the junction of these two resistors. It is thus maintained at a positive potential with respect to the chassis, and in this way the required grid bias is provided. The bias for the two R.F. tubes is obtained through a 320-ohm cathode resistor, and for the detector through a 20,000-ohm resistor. There are three additional resistors in the grid circuits of these tubes, two marked 37,000 but changed in the later models to 60,000-ohms. the third 60,000-ohm resistor connects all three grids to the chassis and acts as an automatic volume control. If a signal is received of sufficient strength to cause grid current to flow in the detector circuit, the resulting voltage drop in this resistor increases the negative bias of the R.F. tubes and thus decreases the amplification in these stages.

TUBE VOLTAGE LIMITS

Filament Voltages

All tubes but rectifier	2.3 to 2.6
Rectifier tube	4.6 to 5.2

Plate Voltages

R.F. tubes	140 to 160
Detector tube	85 to 110
1st Audio tubes	125 to 150
Output tubes	230 to 260

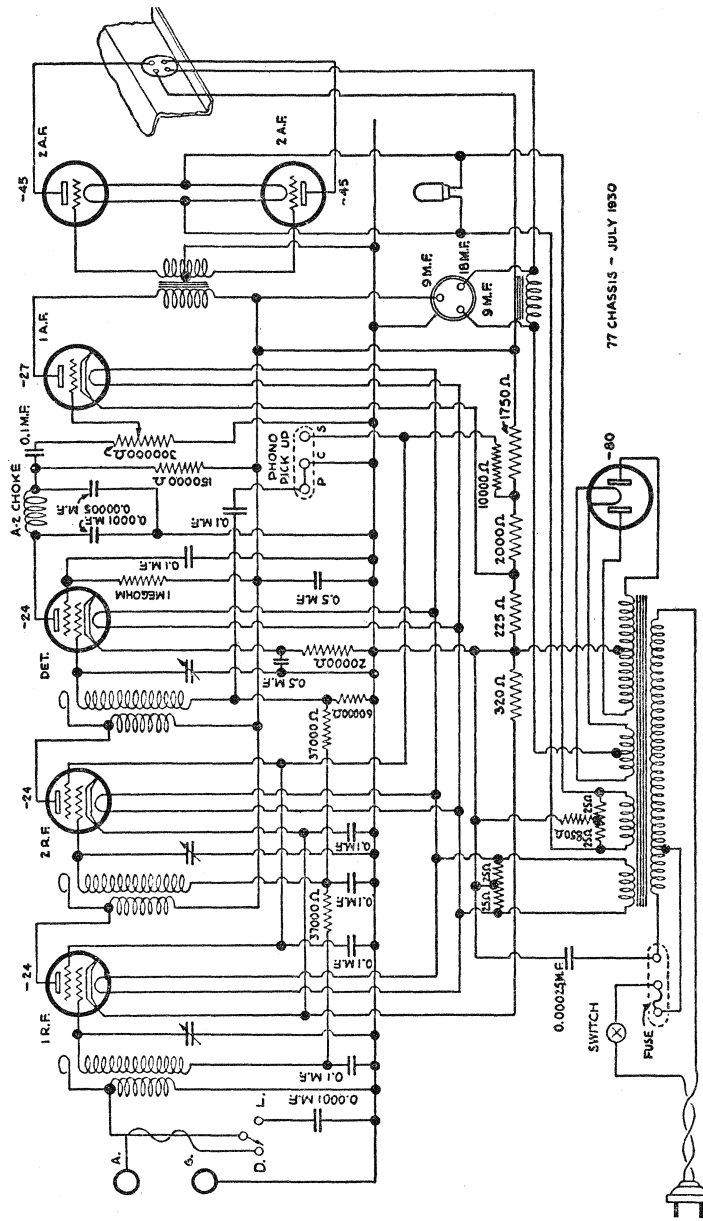
Control Grid Voltages

R.F. tubes	1.6 to 3.2
Detector tube	2.0 to 3.2
1st Audio tube	8.0 to 10.0
Output tubes	45.0 to 65.0

Screen Grid Voltages

R.F. tubes	75 to 90
Detector tube	35 to 55

CROSLEY MODEL 77



AMRAD (CROSLEY) MODEL 84

The Amrad Model 84, also known as the Crosley chassis No. 84, is an 8-tube A.C. chassis that was introduced in the fall of 1930. The chassis is employed in a console type receiver and in a combination radio and electric phonograph. The circuit includes three stages of tuned R.F. amplification with tubes of the 224 type, a tuned grid bias detector with a type 224 tube, a resistance coupled first audio stage with a 227 type tube, and a push-pull output stage with two type 245 tubes. A type 280 full-wave rectifier is used. A special feature of the R.F. transformers is a separate free-end secondary of rather few turns. This gives enough capacity coupling in addition to the inductive coupling to cause uniform response over the entire wave length range. Volume is controlled by means of a 300,000-ohm variable resistor in the grid circuit of the first audio stage. A local-distance switch marked L and D in the circuit diagram is also provided to regulate the energy transference from the antenna to the first R.F. stage.

The power supply system has an input transformer with a tapped primary and four secondaries consisting of three filament windings and a high voltage plate supply winding. With the fuse in the "Low" position the receiver is adapted to operation from 100 to 115 volt circuits, and in the "High" for 115 to 130 volt circuits. From the center tap on the rectifier filament winding the positive side of the high-voltage plate supply circuit passes through the filter system consisting of a choke coil and Mershon condenser to the field coil of the loud speaker. Here the circuit divides and part of the plate current passes through the speaker field coil and returns to the receiver through the second field lead, while the remainder flows through a branch circuit inside the speaker to the midtap on the output transformer primary and thence to the plates of the output tubes. The return lead from the speaker field goes directly to the R.F. and first audio plates and through a 100,000-ohm resistor to the detector plate. Another tap from this return lead goes through a 1-megohm resistor to the screen grid of the detector tube. A bleeder circuit is also tapped off, and consists of three resistors (2500, 1100, and 330 ohms) connected in series to the grounded chassis. The circuit to the R.F. screen grids leads from the junction of the first two resistors through a 10,000-ohm unit to the tubes. The cathode of the first audio tube is biased by being connected to the junction of the 110 and 330-ohm resistors, while the cathodes of the R.F. tubes are biased by being grounded through a 270-ohm unit. The detector cathode is kept positive with regard to the chassis through a 20,000-ohm unit. The control grids of the output tubes are biased through an 860-ohm unit connected between the center tap of a 20-ohm filament resistor and the grounded chassis. The control grids of the R.F. tubes are further biased by being connected to ground through a series of 60,0000-ohm resistors as shown in the diagram. A signal strong enough to cause a flow of current in the detector grid circuit causes a voltage drop across the 60,000-ohm resistor in this circuit, and this drop increases the R.F. grid bias and thereby reduces the amplification in these tubes and hence also the volume.

VOLTAGE LIMITS

Filament Voltages

All tubes but rectifier	2.3 to 2.6
Rectifier tube	4.6 to 5.2

Plate Voltages

R.F. tubes	170 to 190
Detector tube	95 to 105
1st Audio tube	130 to 150
Output tubes	220 to 250

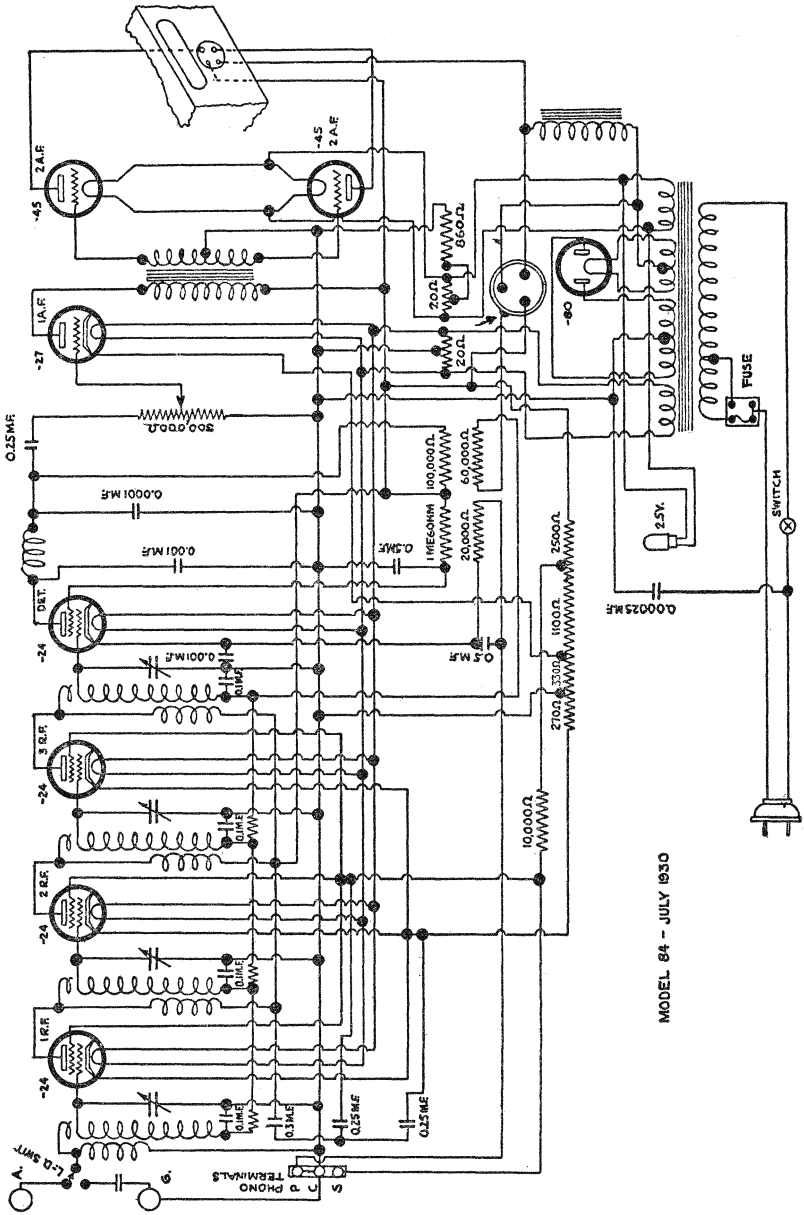
Control Grid Voltages

R.F. tubes	2.5 to 3.5
Detector tube	4.0 to 7.0
1st Audio tubes	8.0 to 11.0
Output tubes	40.0 to 50.0

Screen Grid Voltages

R.F. tubes	60 to 75
Detector tube	35 to 55

AMRAD (CROSLEY) MODEL 84



BOSCH MODEL 54 D.C.

The Bosch Model 54 is a 7-tube receiver designed for operation from a 110-volt direct current line. There are three stages of R.F. amplification with type 224 tubes, a power detector with a 227 tube, a 1st audio stage with a 227 tube, and a second audio stage with two type 171A tubes in push-pull. The tuning system consists of an antenna variometer and three R.F. transformers tuned with a 3-gang condenser, each section of which is provided with a trimmer. The variometer is geared directly to the condenser shaft and assures more uniform sensitivity at both the high and low frequencies. A trimmer condenser C-3, known as the "Clarifier" control adapts the tuner to long and short antennas. C-1 has a capacity of .005 mfds., C-2 has .001 mfds., and C-4 .00025 mfds. A dual volume control is used, one 5000-ohm resistor serving as a potentiometer in the antenna circuit, and the other (also 5000-ohms) for varying the cathode bias of the first R.F. tube. The cathodes of 2nd and 3rd R.F. tubes are biased with individual 1500-ohm resistors bypassed with .5-mfd. condensers C-12 and C-13. Resistors of 250-ohms are also used in the grid circuit of the 2nd and 3rd R.F. tubes.

In the detector circuit a 40,000-ohm biasing resistor is used bypassed by a 1-mfd. condenser. In the plate circuit a filter is used consisting of an R.F. choke and two .001 condensers. L-6 is a choke for filtering the detector plate supply. C-23 is a .005 coupling condenser into the 1st audio stage, while R-11 is a 1-megohm grid leak. R-10 is a 1500-ohm cathode bias resistor bypassed by a 1-mfd. condenser. Standard input and output transformers are used in the push-pull stage. A small C-battery is used here in order to reserve as much as possible of the line voltage for plate supply to the 171A tubes. Two .5-mfd. condensers (C-19 and C-20) bypass the plate circuits of the R.F. tubes to the ground, while three similar condensers (C-16, C-17 and C-18) bypass the screen grid circuits. C-11 across the volume control also has a capacity of .5-mfd.

All the power for operating the receiver is obtained from the 110-volt line. Two line filters (L-8 and L-9) serve to smooth out any voltage variations. The positive side of the line then leads directly to the plate circuit of the output tubes, and another branch continues to the first audio and R.F. tubes through a filter consisting of the choke L-7 and the two 4-mfd. filter condensers C-24 and C-25. The voltage for the screen grids is reduced through a voltage divider consisting of the resistors R-13 25,000-ohms and R-14 15,000-ohms. The filament circuit is also branched off the main line and first passes through the speaker field and three 20-ohm resistors, R-16, R-17 and R-18. The filaments of the first five tubes are connected in series, and the current then passes through the two 171A tubes in parallel. To provide the proper current balance, the two resistors R-15 of 5-ohms and R-19 of 22-ohms are used. Similarly a .75-ohm resistor R-12 is used across the dial light. R-3 and R-4 are two screen resistors the former of 500-ohms and the latter of 25000-ohms. The entire metal chassis is grounded to the negative side of the line.

TUBE VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's	Screen Volts
1st R.F.	224	2.3	100	Variable	1	25
2nd & 3rd R.F.	224	2.3	100	1	1	25
Detector	227	2.3	100	10	1.5	—
1st Audio	227	2.3	95	4	3.5	—
2nd Audio	171A	5.0	110	22½	12	—

BOSCH MODEL 54—D. C.

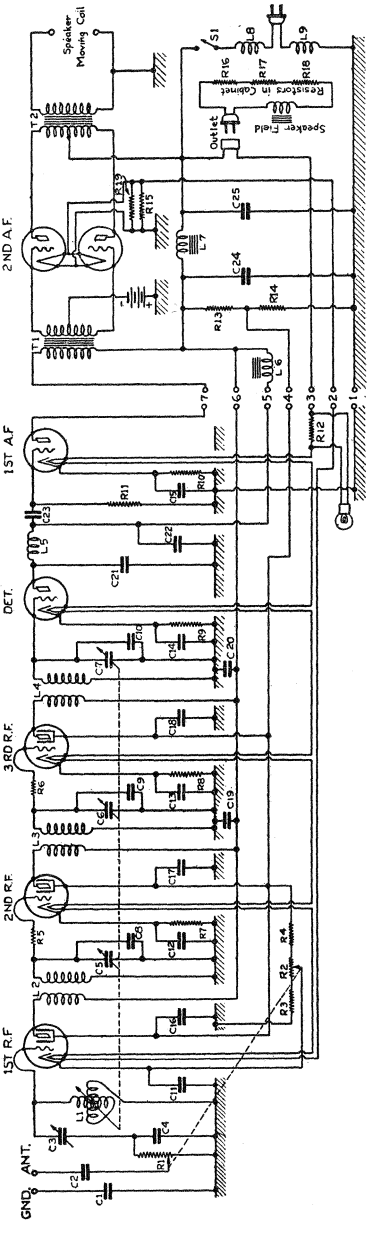


Fig. 3—Schematic Wiring Diagram of the Bosch Model 54 Receiver

BOSCH MODEL 58

The Bosch Model 58 is an 8-tube screen grid receiver. The antenna is coupled to the first tuner through a trimmer condenser which maintains it in tune over the entire broadcast band. This trimmer is provided with a small knob and need be set only when the receiver is installed or when changes are made in the aerial. To adjust this condenser tune in a semi-distant station between 40 and 60 in the dial, reduce the volume until the station can barely be heard, and turn the knob slowly until the loudest reception is had. The condenser gang is made up of two units. The double gang contains the tuning condensers C-1 and C-2 for the first stage. The coupling condenser C-11 (.04 mfd.) and resistor R-2 (1000 ohms) are mounted on the partition between the two sections of the double gang. The two condensers for the third stage C-3 and C-4 are located at the drive end of the three-section gang. The coupling condenser C-15 (.04 mfd.) and resistor R-7 (1000 ohms) are mounted on the partition. The detector tuning condenser C-5 is the end unit of the gang. Alignment condensers (C-7, C-8, C-9 and C-10) are provided for each tuning unit. They are located on the condenser gang and can be reached for adjusting through holes in the top of the chassis. The alignment condensers are adjusted in the same manner as was explained for the antenna trimmer condenser above. A .1-megohm resistor R-6 connected across the primary of the untuned transformer levels down any voltage peaks. The ground resistance R-1 has a value of 500 ohms.

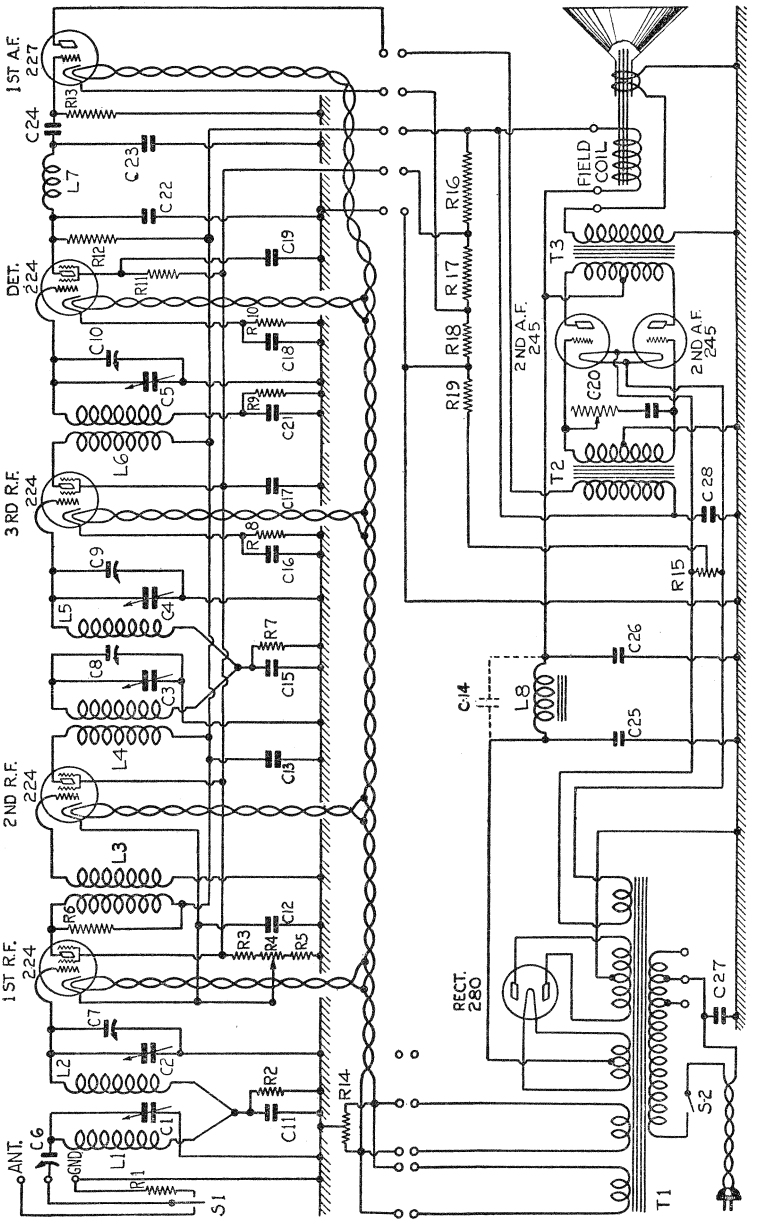
Volume is controlled through a 3000-ohm resistor R-4 in series with the screen resistor R-3 of 20,000 ohms and resistor R-5 of 250 ohms. All three are bypassed by a .5-mfd. condenser C-12. The cathode of the third R.F. tube is biased through R-8 (1000 ohms) bypassed by C-16 (.5 mfd.). The screen grids of the three R.F. tubes are bypassed through C-17, a .5-mfd. condenser. C-13 is a .5-mfd. plate bypass condenser. A 1000-ohm resistor R-9 is in the detector grid circuit to prevent the tube from overloading. It also is bypassed by a .04 condenser C-21. The detector cathode is biased by R-10 a 50,000-ohm resistor which is bypassed by C-18 a 1-mfd. condenser. The detector screen resistor has a value of 1 megohm and the bypass condenser C-19 .5-mfd. In the resistance coupler R-12 has a value of .25 megohm and the 1st audio grid resistor R-13 2-megohms. Condensers C-22 and C-23 each have .0001-mfd. capacity, and the coupling condenser C-24 .006-mfd.

The filter system contains a choke and two condensers C-25. and C-26 of 2-mfds. each. The buffer condenser C-27 is a 1-mfd. unit. The grids of the two power tubes are biased through the 950-ohm. resistor R-19 which is bypassed by the 4-mfd. condenser C-28. The tone control consists of a .5-megohm resistor R-20 in series with a .006-condenser C-20. In the voltage divider R-16 is 2050-ohms, R-17 1950-ohms and R-18 180-ohms.

TUBE SOCKET VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.	Screen Volts
1st R.F.	224	2.2	170	2.2	3	75
2nd R.F.	224	2.2	170	2.2	3	75
3rd R.F.	224	2.2	170	2.2	3	75
Detector	224	2.2	30	1.5	0.1	10
1st A.F.	227	2.2	150	8.0	5.0	—
2nd A.F.	245	2.4	250	50.0	30.0	—
2nd A.F.	245	2.4	250	50.0	30.0	—
Detector	280	5.0	—	—	—	—

BOSCH MODEL 58



BOSCH MODEL 60

The Bosch Model 60 is a 9-tube receiver employing three R.F. stages with type 224 tubes, a grid bias detector with type 224 tube, a resistance coupled 1st audio stage with a 227 tube, and an output stage with two 245 tubes in push-pull. It also contains an automatic volume control system employing a 224 tube. The automatic volume control AVC tube is connected across the detector filament circuit. Its cathode is biased through a 2000-ohm resistor R-22. The plate supply comes through R-17 (900-ohms) and R-16 (.5-megohm). The drop across this latter resistor also forms the C-bias for the two R.F. tubes. The proper screen voltage is obtained through resistor R-19 (25,000-ohms). The grid is connected through wire "g" to the grid of the detector tube. When the receiver signal increases in strength, it results in a higher signal voltage on the detector tube as well as on the grid of the AVC tube. The latter tube as a result draws greater plate current, which in turn causes an increased drop across R-16. But since the drop across this resistor also comprises the C-bias for the first two R.F. tubes, this bias also is increased, the amplification is decreased, and the signal output cut down accordingly. Since such an automatic volume control makes it difficult to tune a receiver to resonance by the sound-intensity method, a visual resonance indicator (milliammeter M) is connected into the cathode circuit of the first two R.F. tubes.

A 500,000-ohm potentiometer is connected into the grid circuit of the 1st audio tube as a manual volume control and operates both for the radio receiver and when a phonograph pick-up is used. The pick-up is connected into the grid circuit of the detector tube. One terminal is permanently connected to ground, while the other is connected to one side of a S.P.D.T. switch, the blade of which is connected to the low end of the tuning coil ahead of the detector. When the switch is thrown one way, the pick-up is connected into the grid circuit and the tube acts as an amplifier. The other way the coil is connected to —C and the tube acts as a grid bias detector. The switch is operated by section C-5 of the tuning condenser when it is turned to the zero end of its movement.

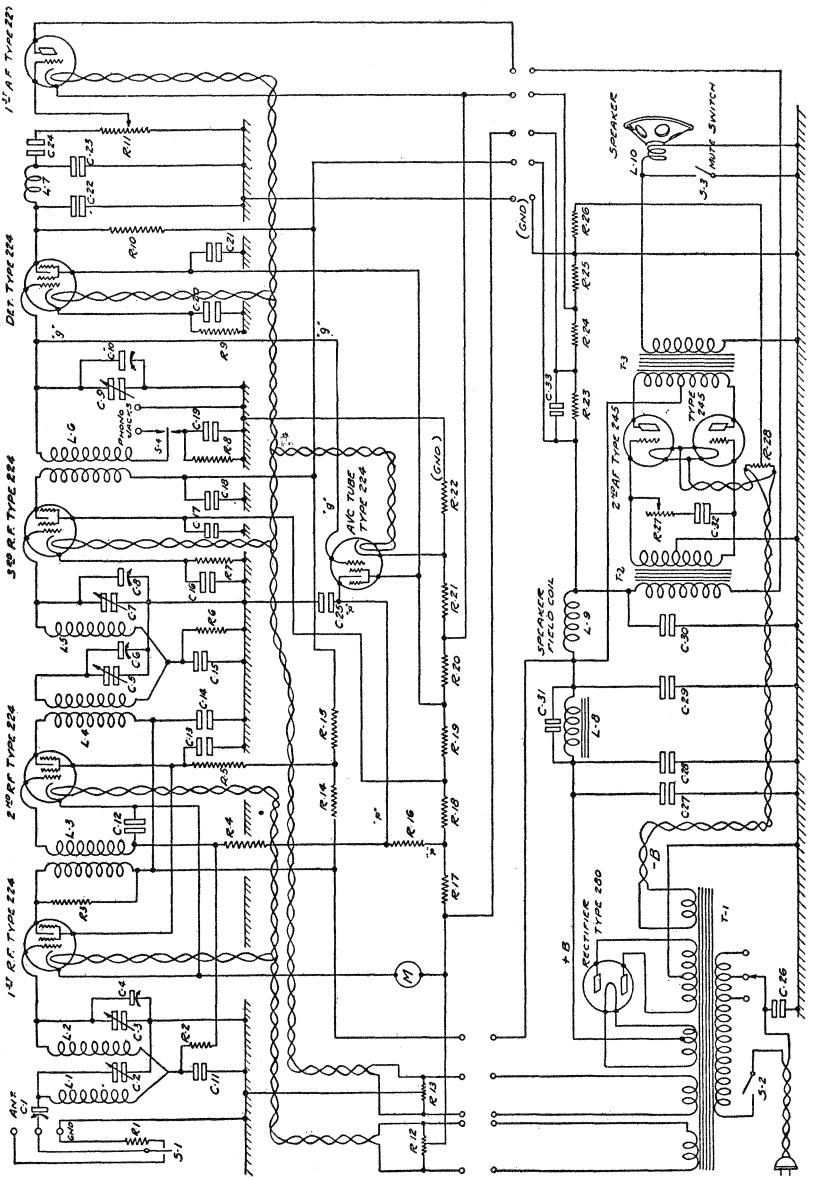
CONDENSER AND RESISTOR VALUES

C-11	.04 mfd	C-23	.0001 mfd	R-1	500	R-18	5000
C-12	.5 mfd	C-24	.006 mfd	R-2	1000	R-20	5000
C-13	.25 mfd	C-25	.006 mfd	R-3	50,000	R-21	2000
C-14	.25 mfd	C-26	.1 mfd	R-4	.5 megohms	R-23	1300
C-15	.04 mfd	C-27	2. mfd	R-5	20,000	R-24	2380
C-16	.5 mfd	C-28	2. mfd	R-6	1000	R-25	160
C-17	.5 mfd	C-29	4. mfd	R-7	1000	R-26	950
C-18	.5 mfd	C-30	2. mfd	R-8	1000	R-27	.5 megohm
C-19	.04 mfd	C-31	.075 mfd	R-9	50,000		
C-20	1. mfd	C-32	.006 mfd	R-10	.5 megohm		
C-21	.5 mfd	C-33	2. mfd	R-14	20,000		
C-22	.0001 mfd			R-15	10,000		

TUBE SOCKET VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.	Screen Volts
1st R.F.	224	2.4	170	2.	3	70
2nd R.F.	224	2.4	180	2.	3.	80
3rd R.F.	224	2.3	185	1.5	2	85
A V C	224	2.3	30	.2	.2	20
Detector	224	2.3	60	1.	.1	10
1st A.F.	227	2.3	150	.1	6.	—
2nd A.F.	245	2.4	250	50.	30.	—
2nd A.F.	245	2.4	250	50.	30.	—
Rectifier	280	5.0	—	—	—	—

BOSCH MODEL 60



THE CLARION RECEIVER — MODELS 51, 53 & 55

The Clarion receiver made by the Transformer Corporation of America and introduced in the fall of 1930, is an 8-tube receiver housed in three types of console cabinets, a lowboy, highboy, and phonograph combination.

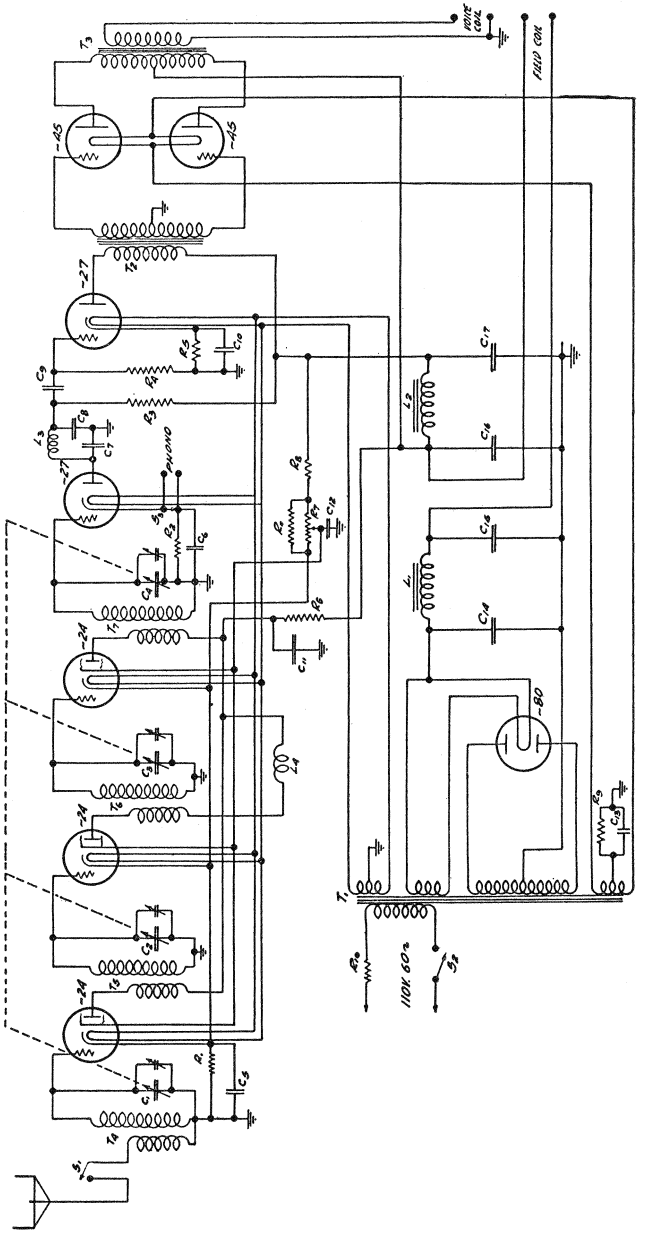
The tuning system consists of four R.F. transformers tuned by a 4-section .00045-mfd. gang condenser, each section being provided with a trimmer. A local-distance switch is used in the antenna circuit. The first R.F. transformer is conductively coupled, but the 2nd, 3rd and 4th are inductively coupled. The grids of the three R.F. tubes are returned directly to ground, while the cathodes are connected together and grounded through a 140-ohm biasing resistor R-1 which is bypassed by a .1-mfd. condenser C-5. The grid of the detector is biased by grounding the cathode through a 20,000-ohm resistor R-2 bypassed by a .75-mfd. condenser C-6. Phonograph pick-up connections are also made directly into the cathode circuit, the pick-up being cut in or out by means of a single-pole switch S-3. In the detector plate circuit an R.F. filter is used consisting of a 9-millihenry choke L-3 and two .001 condensers C-7 and C-8. The first audio coupler consists of a 50,000-ohm plate resistor R-3, a 1-megohm grid leak R-4, and a .1-mfd. blocking condenser C-9. In the second stage a standard input and output transformer T-3 and T-4 are used, the output secondary having a low impedance and feeding directly into the voice coil of the dynamic speaker. The first audio tube is biased through a 3800-ohm cathode resistor R-5 which is bypassed by a .75-mfd. condenser C-10. The two 245 output tubes are biased through a 900-ohm resistor R-9 also bypassed by a 1-mfd. condenser C-13 and connected between the ground and the center tap on the filament secondary winding supplying these tubes.

In the power supply system the input transformer T-1 has a voltage regulating resistor in series with the primary side. There are three filament supply secondaries and a high-voltage plate supply winding. The filter contains two choke coils L-1 and L-2 with the dynamic speaker field connected between them. Four 1.5-mfd. sections of filter condenser C-14-15-16-17 are employed. The plate supply to the two output tubes is tapped off between the speaker field and the second choke L-2, while the voltage drop in this second choke reduces the pressure to the proper value for the 1st audio and detector tubes. A tap is taken from the first high voltage line and leads through a 10,000-ohm resistor R-6 (bypassed by the .4-mfd. condenser C-11) to the plate circuits of the three R.F. tubes. Another tap from the output circuit leads through an 11,500-ohm resistor R-8 in series with a 25,000-ohm potentiometer R-7 which serves as a volume control by regulating the voltage supplied to the screen grids of the R.F. tubes. This potentiometer is shunted by a 16,700-ohm resistor R-11 and is also bypassed to ground by the .25-mfd. condenser C-12.

TUBE VOLTAGES AT 125 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Cathode	Plate Mills.	Screen Grid
1st R.F.	224	2.47	158	3	3	6.5	84
2nd R.F.	224	2.47	158	3	3	7.8	84
3rd R.F.	224	2.47	156	3	3	7.9	84
Detector	227	2.47	157	12.6	13.5	.85	—
1st A.F.	227	2.48	198	1.	16	4.2	—
2nd A.F.	245	2.55	227	42.	—	22.	—
2nd A.F.	245	2.55	225	42.	—	27	—
Rectifier	280	5.3	—	—	—	41	—

CLARION MODELS 51, 53 AND 55



CLARION JR. MODELS A.C.-60 AND 25-60

The Clarion Jr. Models A.C.-60 and 25-60 are 6-tube receivers of the midget type manufactured by The Transformer Corporation of America and marketed in the fall and winter of 1930. The circuit employed includes two stages of tuned R.F. amplification with type 224 tubes, a power detector also with a 224 tube, and a push-pull audio stage with two type 245 tubes. The receivers are designed to be operated with a standard aerial from 30 to 60 ft. long, and must have a good ground connection for consistent operation.. Three terminal posts are provided at the rear of the chassis, marked ANT, GND, and the third one blank. If the antenna is connected to this post, the local distance switch will be inoperative. In the local position of the switch opens the antenna lead and the signal is imparted to the set through the capacity coupling existing between the switch leads alone. The ground wire must not be connected to the antenna post unless a fixed condenser is connected in series.

The tuning system consists of an antenna coupler and two R.F. transformers all tuned with a 3-gang .00042-mfd. condenser, each section of which is provided with an individual trimmer. In addition to the inductive coupling of the R.F. transformers, small coupling condensers C-13 and C-14 of 12 mfd. capacity are also employed in the R.F. stages. These provide more uniform response over the entire wave length range. The cathode of the detector is biased through a 40,000-ohm resistor R-3 bypassed by a 0.35-mfd. condenser C-10. The plate circuits of the R.F. tubes are also bypassed to ground through a 0.25 condenser. The grids of the power tubes are biased through the speaker field serving as a resistor connected between the ground and the center tap on the filament winding. A tone control is used in the form of a toggle switch connecting a 0.006-mfd. condenser across the grids of the two power tubes.

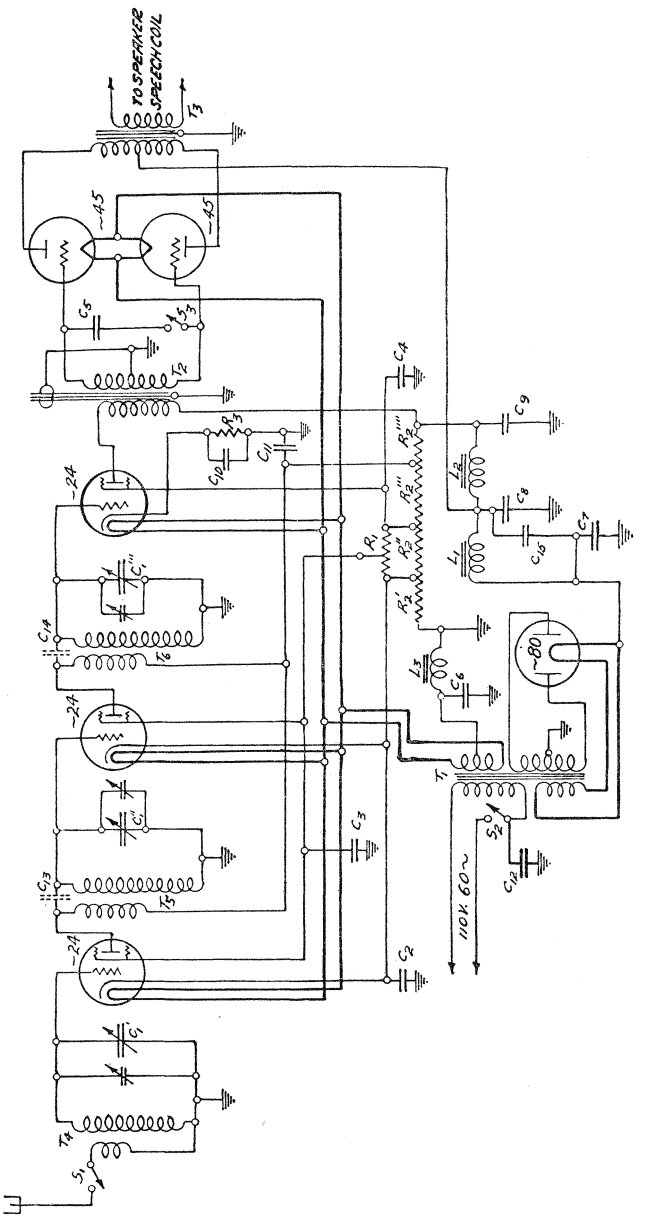
In the power supply the input transformer has a 110-volt primary with one side filtered to ground through a 0.05 mfd. condenser C-12, and three secondary windings. A Type 280 rectifier is used. The filter system contains two choke coils L-1 and L-2 and four filter condensers: C-7 and C-8 1.5 mfds., C-9 .05 mfd. and C-15 0.2 mfd. The power supply to the two chokes is tapped off between the two chokes. The voltage divider consists of four sections with the following resistance values beginning at the high voltage end: 4600-ohms, 8200-ohms, 13,400-ohms, and 167-ohms. The third section is shunted by a 25,000-ohm variable resistor R-1 which serves as a volume control by regulating the screen grid voltage of the two R.F. tubes. The screen grids are bypassed to ground through a 0.25-mfd. condenser C-3. The detector screen grid is bypassed by condenser C-4 also 0.25 mfd. The fourth section biases the cathodes of R.F. tubes, the cathodes being bypassed to ground through a 0.1-mfd. condenser C-2. The plate circuits of the R.F. tubes are bypassed through condenser C-11, 0.25 mfd.

TUBE VOLTAGES AT 125 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills	Cath. Volts	Screen Volts
1st R.F.	224	2.55	197	3.1	2.7	50	97
2nd R.F.	224	2.55	197	3.1	3.0	50	97
Detector	224	2.55	250	8.0	0.2	32	86
Audio	245	2.65	276	52	35	—	—
Audio	245	2.65	276	52	31	—	—

To obtain the maximum efficiency from the set, the antenna trimmer should be adjusted to the length of the aerial being used. This adjustment should be made at about 1200 kilocycles. Adjusting it at 1500 kilocycles or thereabouts, will not give the desired results.

CLARION JR., MODELS A. C.-60 AND 25-60



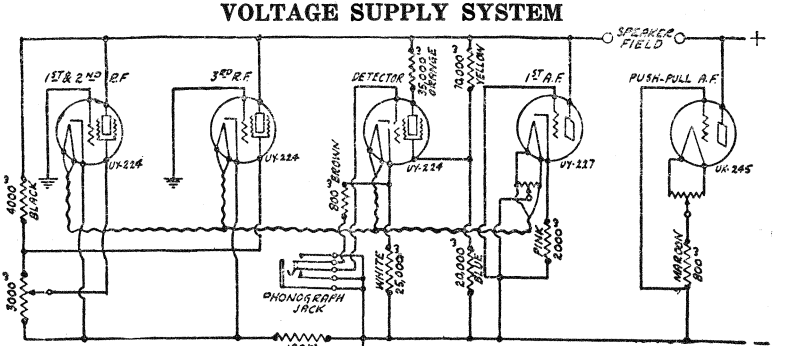
BRUNSWICK MODELS S-14, S-21 AND S-31

The Brunswick Models S-14 and S-21 employ the same chassis and power pack as is used in the Bremer-Tully Models S-81 and S-82. The S-31 is a combination radio and phonograph and also employs the same chassis but a slightly different power unit. The circuit data given for the Bremer-Tully models S-81 and S-82 therefore also applies to these Brunswick models. The power unit and audio amplifier for the S-31 is given on the next page. It is similar to the B-T power units previously described but has additional provisions made for the phonograph motor and pick-up. An input transformer is also provided so that the impedances of the pick-up and audio input circuit will be properly matched.

— An interesting feature of these circuits is the voltage supply system which is illustrated schematically below. Beginning at the positive terminal of the B-supply, a tap is first taken off for the two 245 power tubes. Next in series is the speaker field which serves as a voltage drop resistor. It has a resistance of 4750 ohms and dissipates 160 volts. The next tap is taken off the first audio tube. Another tap is taken off with a 70,000 ohm resistor in series with a 20,000-ohm unit, and the bleeder or dissipation current through the first resistor reduces the voltage to the proper value for the screen grid of the detector tube. The next tap with a 35,000-ohm resistor in series feeds directly to the plate of the detector. The plates of the three R.F. tubes are connected directly to the line. The main circuit then leads through a 4000-ohm unit and the voltage is reduced to the value needed for the screen of the third R.F. tube. The 3000-ohm volume control resistor is next in line for varying the voltage supplied to the screens of the first two R.F. tubes. Lastly in the line is a 100-ohm resistor to provide the necessary control grid bias for the three R.F. tubes.

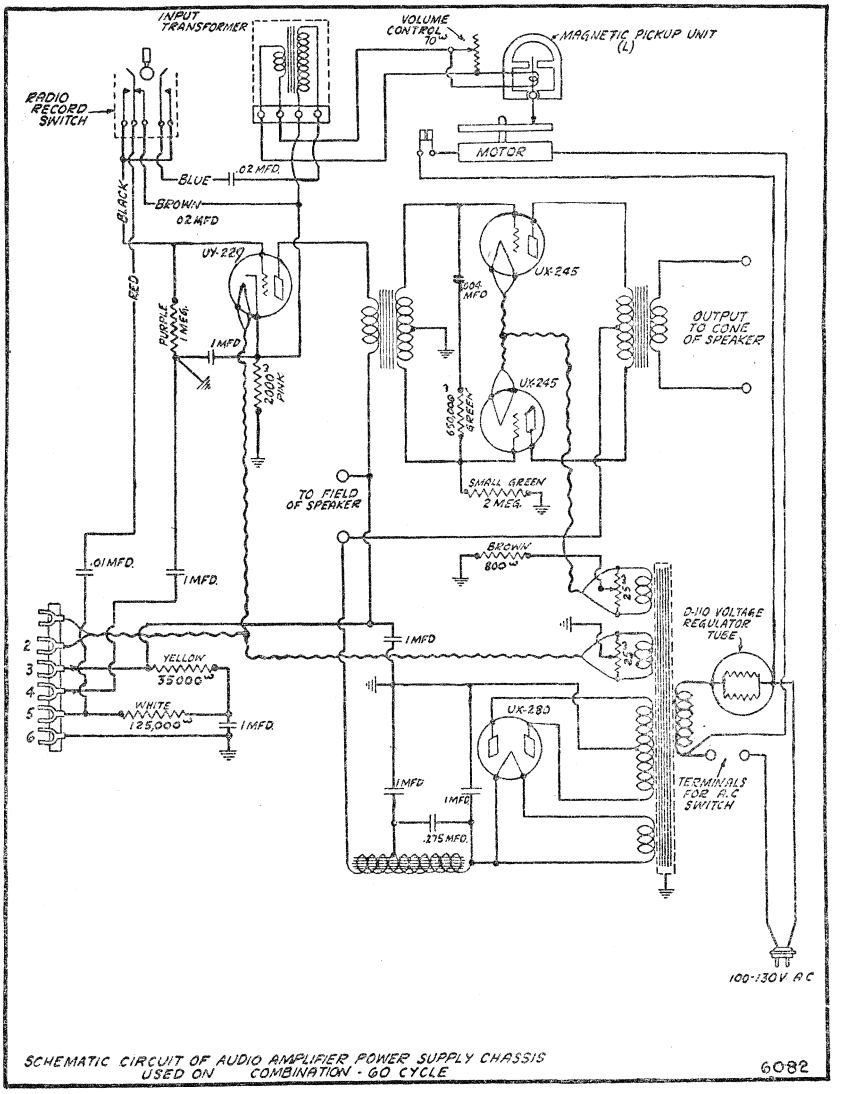
A prominent hum may be due to wrong plate voltages, poor detector or first audio tube, defective filter choke, broken down filter condenser, or defective input transformer. Oscillations may be caused by poor R.F. tubes, loose shielding, poor contacts on condenser rotor, or reversed antenna loading coil. Poor sensitivity may be due to weak tubes, defective R.F. plate choke coil, open antenna loading coil, or condenser out of alignment. Noises may be caused by a loose connection in the antenna or ground circuit, or by a poor contact somewhere in the wiring of the receiver. Line noises can generally be pretty well eliminated with the aid of line condensers or suitable filter devices. Leaky condensers and broken down insulation may also be sources of noises.

VOLTAGE SUPPLY SYSTEM



BRUNSWICK MODELS 14S, 21S AND 31S

Power Supply



SCHEMATIC CIRCUIT OF AUDIO AMPLIFIER POWER SUPPLY CHASSIS USED ON COMBINATION - 60 CYCLE

6082

BRUNSWICK MODELS 15 AND 22

The Brunswick Models 15 and 22 are 7-tube A.C. screen-grid receivers introduced in the fall of 1930. The circuit involves three stages of tuned radio frequency amplification with tubes of the 224 type, a grid bias or power detector with a type 224 tube, and a single audio stage with two type 245 tubes in parallel (not push-pull). A tuned antenna coupler is used with a local-distance switch in the primary circuit. In the "local" position the antenna is connected to ground through a .0002 condenser, while in the "distance" position the antenna is connected through a loading coil in series with the coupler primary to ground. Three stages of tuned impedance coupling follow, with a 5.4-mh. choke coil in the plate circuit, which in turn is coupled to the following grid circuit through a 10-mfd. condenser. The volume control consists of a 0-10 mmfd. variable coupling condenser in the first stage. This type of control is noiseless, and always permits the tubes to operate at maximum efficiency.

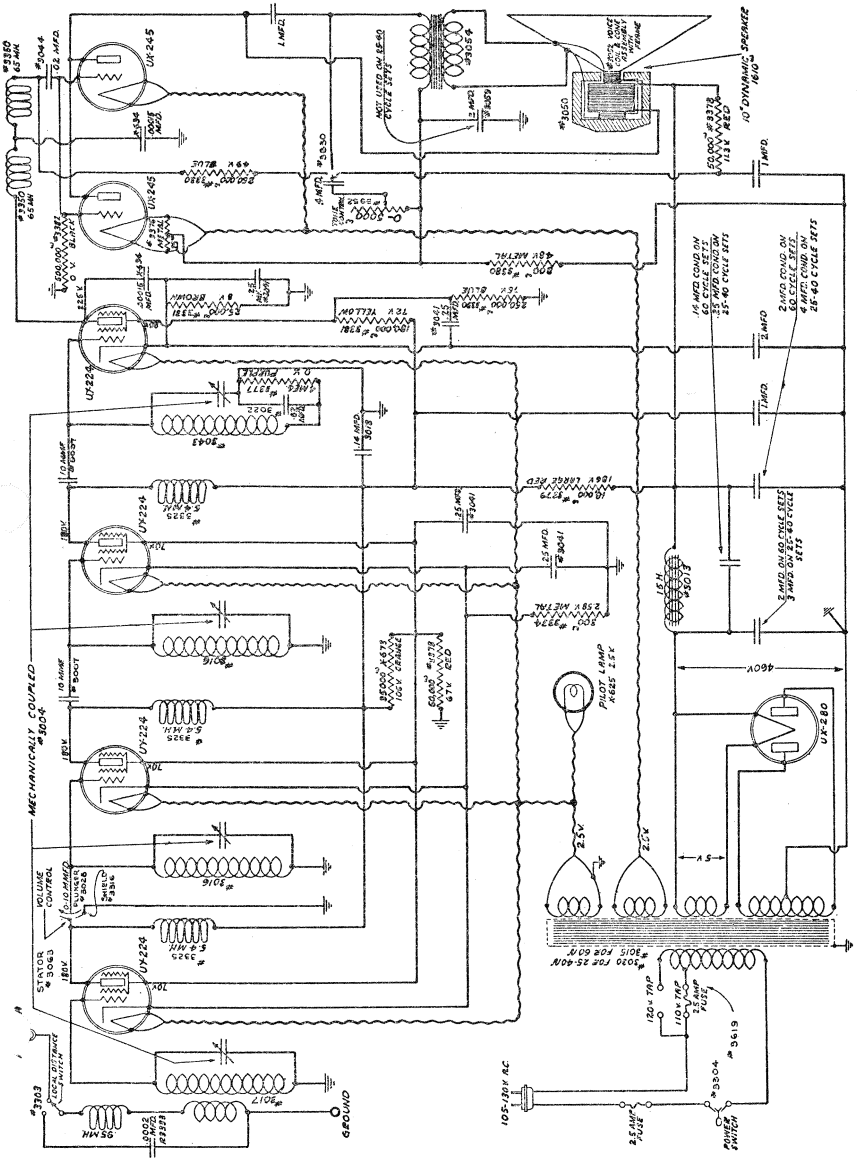
In the tuned circuit of the detector input a 4-megohm resistor is used bypassed by a .02-mfd. condenser. This resistor serves to prevent the detector from overloading. The grid of the detector is biased through a 25,000-ohm cathode resistor which is bypassed by a .25-mfd. condenser. Two 65-mh. choke coils are used in the plate circuit of the detector followed by a 250,000-ohm coupling resistor. A .02-mfd. blocking condenser then couples the circuit to the grids of the two output power tubes. A 500,000-ohm grid leak is also used, converting the system into a form of resistance coupling. The grids of the power tubes are biased through an 800-ohm resistor connected between the center tap of a 25-ohm filament resistor and the ground. A standard output transformer is used coupled to the plate circuit through a 1-mfd. condenser. The tone control consists of a 5000-ohm variable resistor connected in series with a .4-mfd. condenser across the primary of the output transformer. It is operated from a separate knob mounted on the front panel of the receiver directly below the main tuning control.

In the power supply system the input transformer has a tapped primary and four secondaries, three filament windings and a high-voltage plate supply winding. A type 280-full-wave rectifier is used. The filter system contains a 15-henry choke and two 2-mfd. filter condensers. The choke is tuned with a .14-mfd. condenser to suppress any 120-cycle hum. The speaker field serves as a second filter choke. It has a field resistance of 1600-ohms and requires an excitation current of 64 milliamperes. Two taps are taken off the high voltage line, the first leading through an 18,000-ohm resistor to the plate circuits of the three R.F. tubes and through two sub-taps, one to the screen grids of these tubes with a 25,000-ohm series resistor and the other to the detector screen grid with a 180,000-ohm series resistor. A 60,000-ohm bleeder resistance is also taken off the R.F. screen grid circuit. The other main tap leads from the high-voltage line through a 50,000-ohm resistor to the plate circuit of the detector.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills	Cathode	Screen Grid
1st R.F.	224	2.5	178	2.5	2.2	2.5	60
2nd R.F.	224	2.5	178	2.5	2.2	2.5	60
3rd R.F.	224	2.5	178	2.5	2.6	2.5	60
Detector	224	2.5	180	—	0.36	8.	24.3
Audio	245	2.5	242	12	30	—	—
Audio	245	2.5	242	12	30	—	—
Rectifier	280	4.8	385	—	40	—	—

BRUNSWICK MODELS 15 AND 22



THE HOWARD GREEN DIAMOND

The Howard Green Diamond made by the Howard Radio Company was introduced in the fall of 1928. It is an eight tube receiver of the neutrodyne type. The antenna circuit is coupled to the first tube through a 3000-ohm potentiometer, and three stages of tuned R.F. amplification follow. These first four tubes are of the 226 type. A tuned input detector with grid leak and condenser uses a 227 type tube, and this is coupled to the first audio tube (of the 226 type) through an audio transformer with a tapped primary winding. By means of a double-throw switch the detector plate circuit is connected across the entire primary or a phonograph pick-up across a section of it so that proper impedance relations are maintained.

The power supply system has an input transformer with a tapped primary and five secondaries, four filament windings and a high-voltage plate supply winding. Only one filter choke is used, and the plate supply for the two output tubes is tapped off before the circuit enters the choke. A hum bucking circuit connected in parallel with the plate supply is used at this point and consists of a 3000-ohm resistor R-18 in series with a .5-mfd. condenser C-25. Resistor R-5 has a value of 3800-ohms, the series resistor R-6 3000-ohms, R-8 50,000-ohms, and R-11 the grid biasing resistor a value of 450-ohms. R-9 is a 10-ohm center tapped filament resistor and R-10 a similar 40-ohm unit. R-2 is a 5000-ohm audio frequency volume control that regulates the volume both from the radio receiver and the phonograph pick-up. R-12 and R-17 are 200-ohm grid resistors, and R-13, R-14, R-15 and R-16 are 200-ohm plate filter resistors.

In later models the push-pull output choke was replaced with an output transformer that was built into the speaker. Also, the speaker field was used as a second filter choke, with a tap taken off at the high potential side of the field to the midtap on the output transformer primary for the plate supply to the output tubes.

Tube Voltages at 115 Volts Line Pressure — 171A Push-Pull

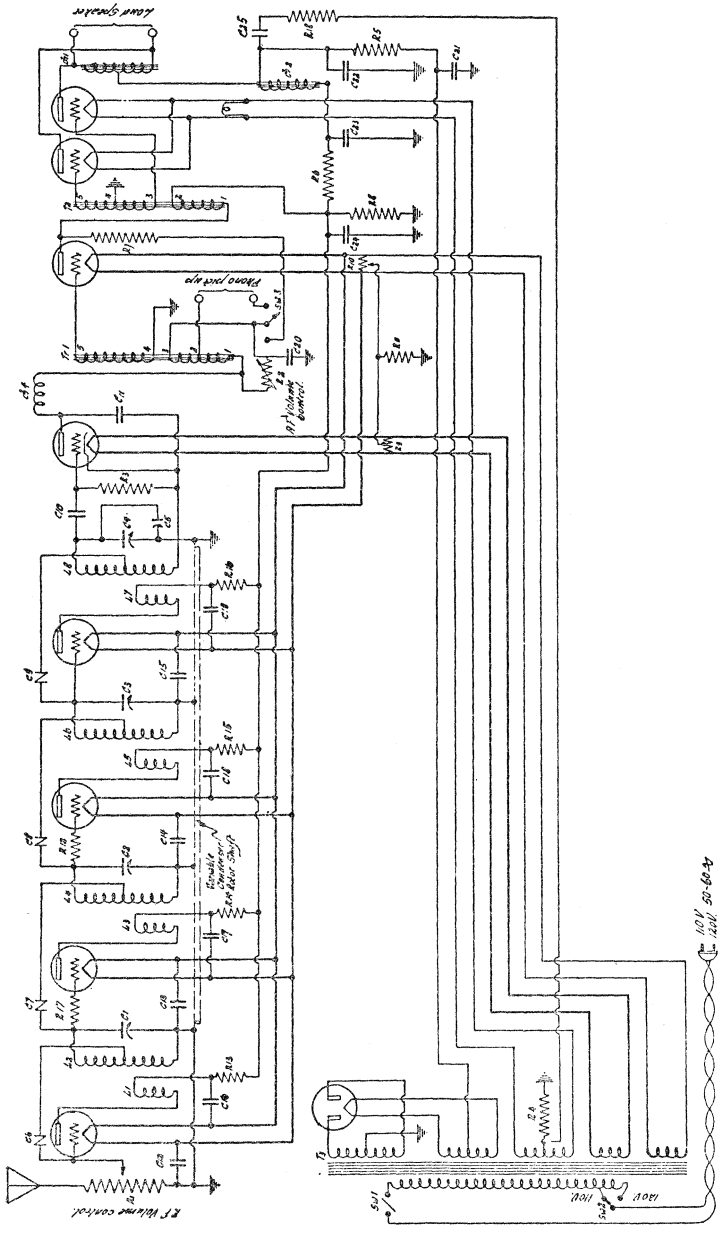
Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills.
1st R.F.	226	1.2	132	9	4.4
2nd R.F.	226	1.2	132	9	4.4
3rd R.F.	226	1.2	132	9	4.4
4th R.F.	226	1.2	132	9	4.4
Detector	227	2.1	23	0	1.4
1st A.F.	226	1.2	124	8	4.4
2nd A.F.	171	4.4	161	32	13
2nd A.F.	171	4.4	161	32	13
Rectifier	280	4.5	—	—	26

When the 245 tubes became available early in 1929, these tubes were used in the output stage in place of the 171A tubes. Otherwise the circuit remained the same.

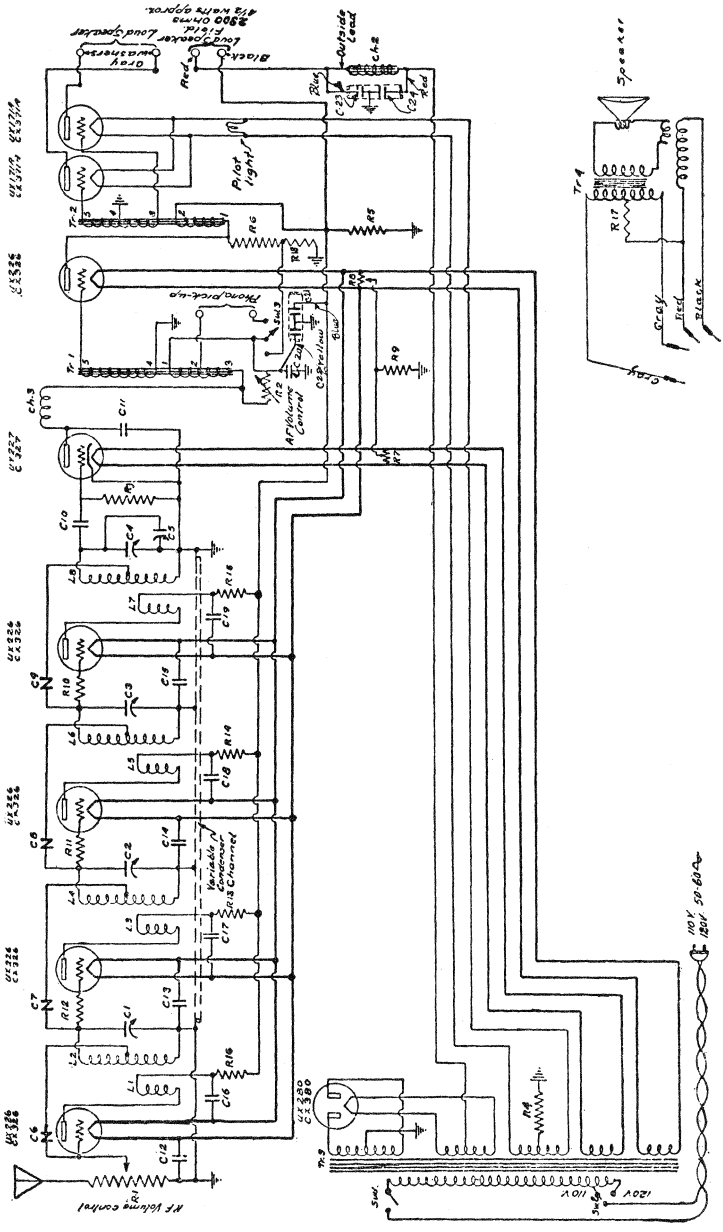
Tube Voltages at 115 Volts Line Pressure — 245 Push-Pull

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mills.
1st R.F.	226	1.50	124.6	8.6	3.20
2nd R.F.	226	1.49	124.6	8.6	3.15
3rd R.F.	226	1.43	124.0	8.8	3.10
4th R.F.	226	1.43	124.0	8.9	3.05
Detector	227	2.44	20.8	—	1.0
1st A.F.	226	1.40	119.3	8.0	2.6
2nd A.F.	245	2.36	241.3	40.5	20.0
2nd A.F.	245	2.38	240.6	40.5	19.8
Rectifier	280	4.50	—	—	51.6

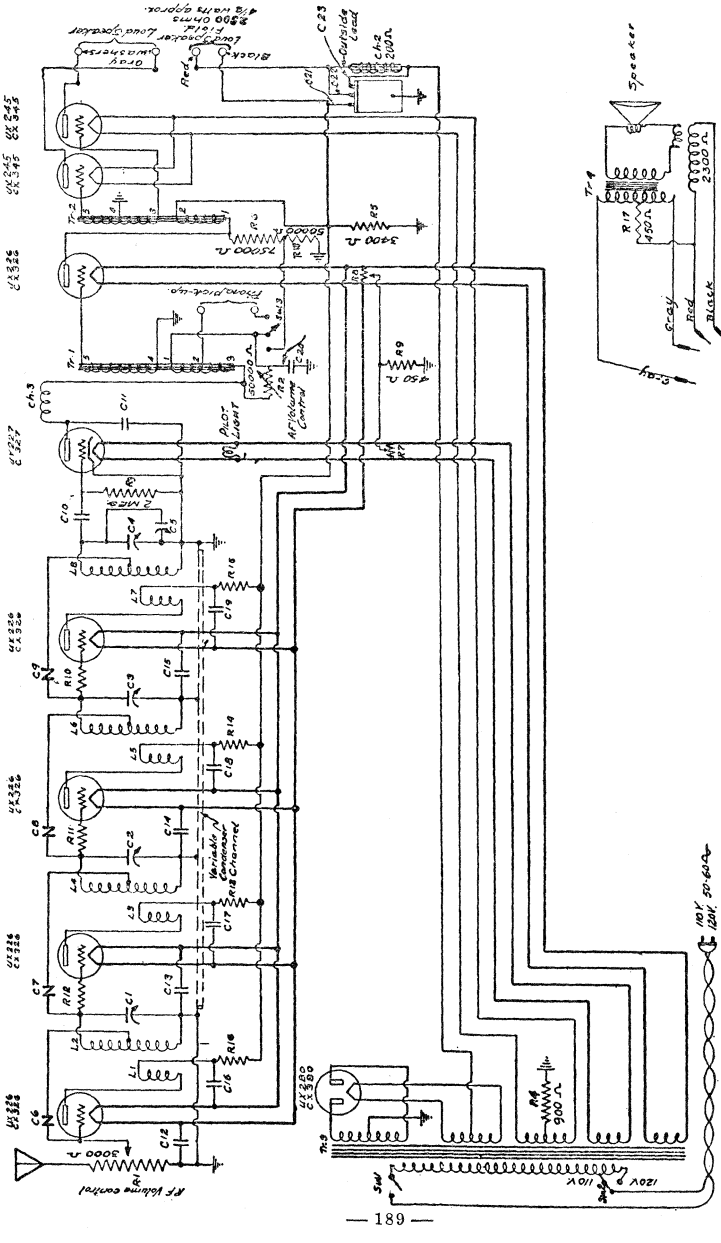
HOWARD GREEN DIAMOND



HOWARD GREEN DIAMOND



HOWARD GREEN DIAMOND



THE HOWARD S. G. RECEIVER — MODEL A

The Howard Model A screen grid receiver is a 7-tube A.C. set built up in three separate units, the chassis, the power pack, and loud speaker. The chassis contains the tuning system, the R.F. and detector stages, and the push-pull input transformer. The circuit employs three stages of tuned R.F. amplification with tubes of the 224 type, a grid-bias detector with a type 227 tube, and a push-pull audio stage with two type 245 power tubes. The antenna input is a 3000-ohm resistor that forms part of a dual volume control, the other section being a 10,000-ohm unit in series with a 300-ohm fixed resistor (both bypasses with a 1-mfd. condenser) for controlling the cathode bias of the three R.F. tubes. The tuning system consists of four R.F. transformers tuned with a 4-gang condenser. The detector cathode is biased through a 15,000-ohm resistor which is bypassed by a 1-mfd. condenser. In the plate circuit of this tube is an R.F. filter consisting of a 10 millehenry choke coil and two .001-mfd. condensers. A 2½-volt pilot lamp is connected directly across the filament circuit of the first four tubes. A 10-ohm center-tapped resistor with the tap grounded is also connected across this filament circuit to eliminate any A.C. hum. The plates of the four tubes are all supplied from the same 175-volt line, but the circuit is bypassed to ground with a .5-mfd. condenser so that there is no danger of oscillation due to radio frequency coupling in the power pack resistors. The push-pull input transformer is of special design in that it is wound with a very high impedance primary. This means a high voltage built up in the primary, and a consequently higher voltage in the secondary due to the ratio of transformation. The screen grids of the R.F. tubes are connected together and to the 70-volt tap on the voltage divider. This lead is also bypassed to ground with a 1-mfd. condenser.

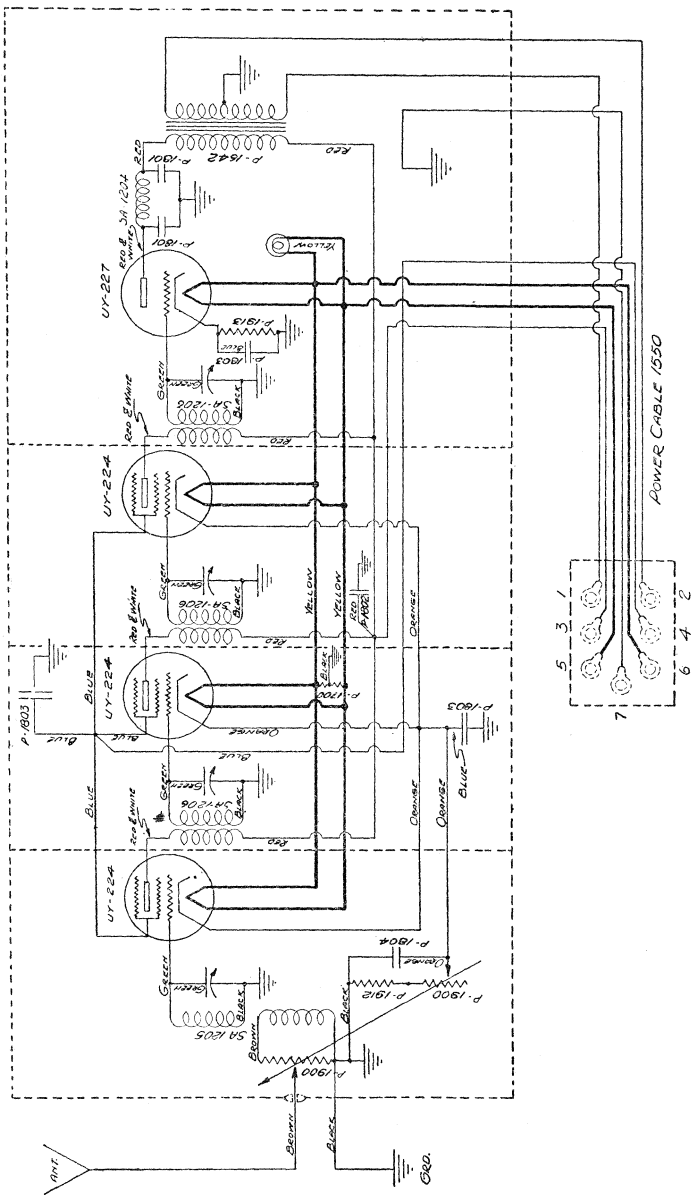
The power pack has an input transformer with three primary taps for 100, 110 and 120-volt lines, and four secondaries—three filament windings and a high voltage plate supply winding. A type 280 full-wave rectifier is used. The filter system consists of a choke coil and a 3-section Mershon electrolytic condenser, the speaker field serving as a second choke. The main choke coil has a D.C. resistance of 200-ohms and an inductance of 20 henry's at 100 milliamperes. Its alternating current impedance is about 15,000 ohms. A 4800-ohm voltage dividing resistor is used with a tap taken off for the screen grid voltage. The lower section of this resistor serves as a biasing unit for the two power tubes, and is connected to the center tap on a 10-ohm resistor connected across filament circuit supplying these tubes.

An electrodynamic speaker is used with a 2400-ohm field coil which as was stated above serves as a filter choke. The push-pull output transformer is built into the speaker, and has the center tap on the primary winding connected directly to the high potential side of the field coil for the plate supply to the output power tubes.

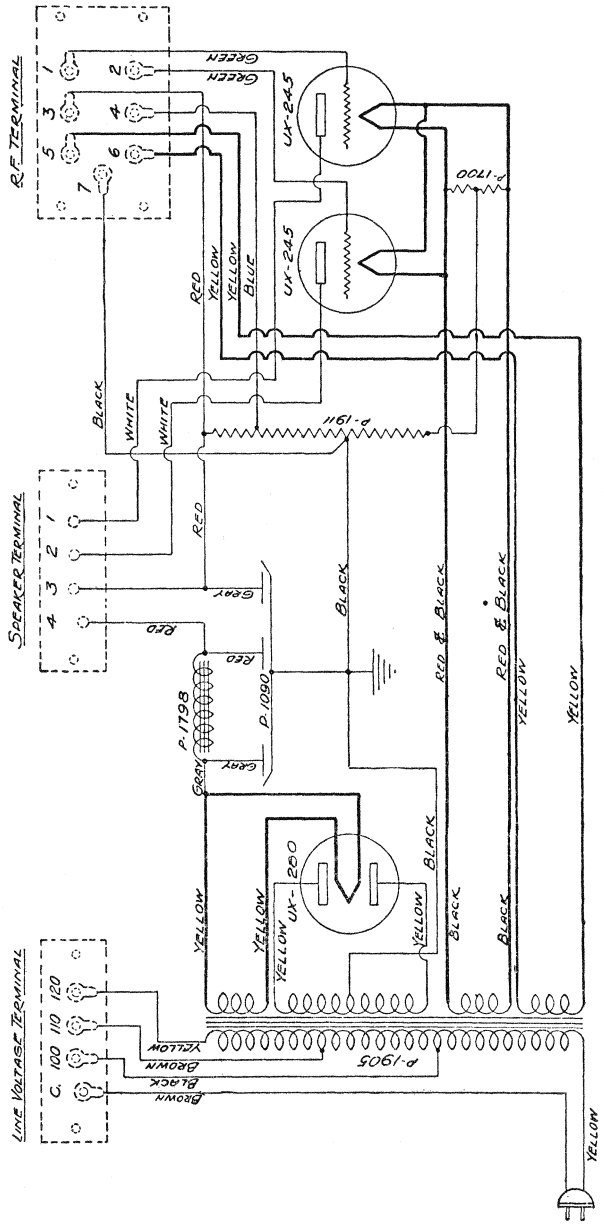
TUBE VOLTAGES AT 110 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Cathode	Plate Mills.	Screen Grid
1st R.F.	224	2.3	164	2.88	3.12	3.6	68
2nd R.F.	224	2.3	164	2.88	3.12	3.6	68
3rd R.F.	224	2.3	164	2.88	3.12	3.6	68
Detector	227	2.35	152	14.7	12.4	1.1	—
Output	245	2.18	254	48.	—	26	—
Output	245	2.18	254	48.	—	26	—
Rectifier	280	4.56	—	—	—	—	—

THE HOWARD S. G. RECEIVER—MODEL A



HOWARD MODEL S. G. A.



KENNEDY MODEL 26

The Kennedy Model 26 chassis was marketed in the fall and winter of 1930 and 1931, and employed an 8-tube circuit with three stages of R.F. amplification using type 224 tubes, a grid bias detector with a type 227 tube, a resistance coupled first audio stage also with a type 227 tube, and a push-pull output stage with type 245 tubes. The chassis is built up in two units, the radio frequency tuner as one unit and the power supply and audio amplifier as another unit. The tuning system consists of an antenna coupler and three R.F. transformers all tuned with a 4-gang condenser. Each of the R.F. tubes is provided with its individual cathode biasing resistor suitably bypassed. The values of all biasing resistors and bypass condensers are clearly indicated in circuit diagram. A dual volume control is used consisting of a 10,000-ohm potentiometer across the primary of the antenna coupler and a 50,000-ohm potentiometer for regulating the screen grid voltage of the three R.F. tubes. A tone control is also employed consisting of a 50,000-ohm variable resistor in series with a .04-mfd. condenser and connected across the output of the detector tube after the R.F. filter.

The input transformer primary in the power supply unit is provided with an 80-volt tap and the chassis contains an extra socket for a voltage regulator tube. Receivers are normally shipped with a plug in this socket which contains a line fuse and which automatically connects the line through the fuse to the 120-volt primary tap. This arrangement will supply sufficiently accurate voltages to the set between line voltages ranging from 108 to 125 volts. When the line voltage is low (under 110) or high (over 125) or subject to wide fluctuations, the plug should be removed and a line voltage regulator tube or ballast tube inserted in its place. This will aid in holding set voltages at normal values. Suitable regulator tubes can be obtained from any Kennedy distributor. The rectifier (with a 280 type tube) and filter circuits as well as the audio amplifier are of standard design. The dynamic speaker field which has a resistance of 2250-ohms serves as a second filter choke. The audio output transformer is built into and forms an integral of the speaker.

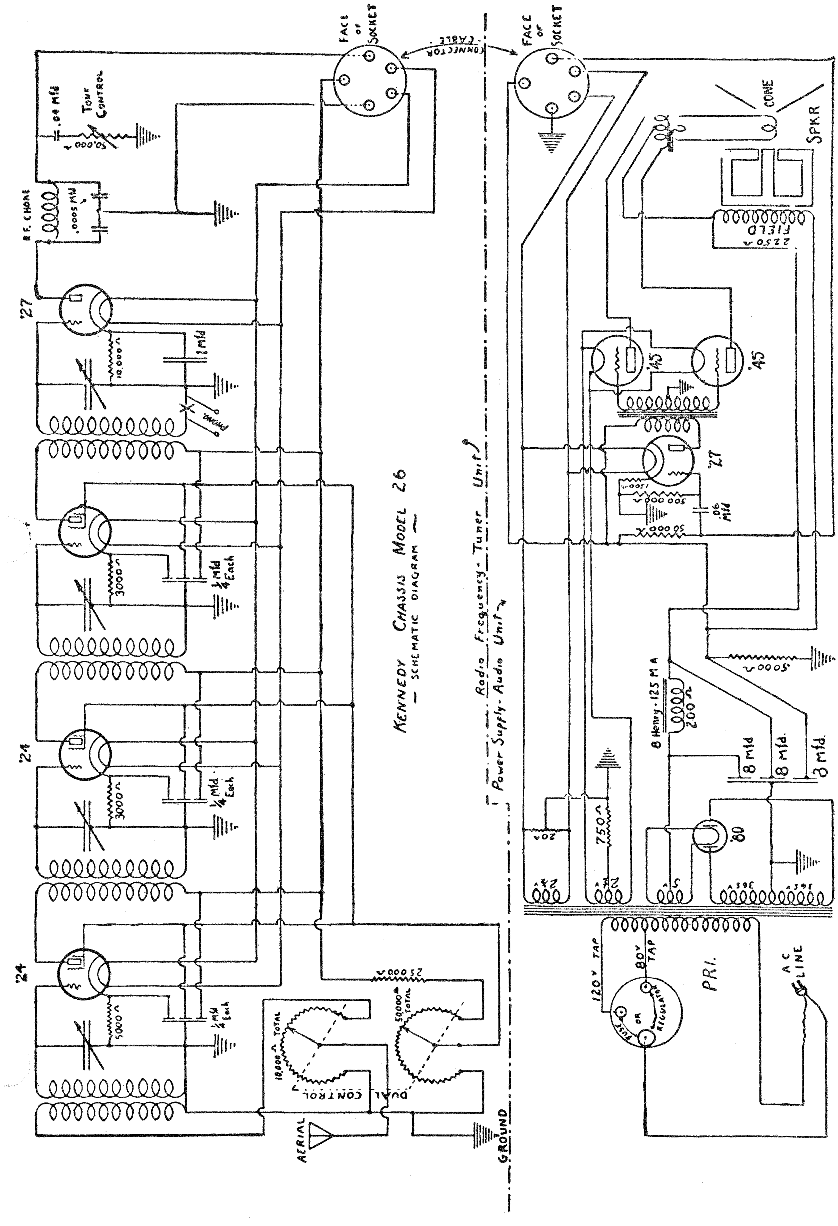
Phonograph pick-up terminals are provided connected into the tuned input circuit into the detector. The phonograph switch is mounted in the rear corner of the R.F. base and is composed of two contact arms, one of which is insulated from the base and connected to the ground return of the detector coil. The contacts are closed for radio reception and open for phonograph reproduction. A cog on the rear of the dual volume control actuates a bakelite push-rod which in turn operates against the phono-switch arms. When the volume control is tuned to the full "off" (extreme left) position, the phono-switch automatically opens.

All receiving sets are properly balanced at the factory and cannot readily get out of adjustment. In case it becomes necessary to change a coil, it is best to change all four coils for a new set of four matched and impregnated coils that are designed to work together.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Screen Volts
1st R.F.	224	2.3	160	3.5	85
2nd R.F.	224	2.3	160	3.5	85
3rd R.F.	224	2.3	160	3.5	85
Detector	227	2.3	125	10.0	—
1st A.F.	227	2.3	135	9.0	—
Output	245	2.3	230	45.0	—

KENNEDY MODEL 26



KENNEDY MODELS 30 AND 32

The Kennedy chassis No. 30 and 32 were marketed in the fall and winter of 1930 and 1931. They employ an 8-tube circuit with type 224 tubes in the three R.F. stages, a type 227 tube in the detector (grid bias type), another type 227 in a resistance coupled first audio stage, and two type 245 tubes in push pull in the output stage. The output transformer is built directly into the dynamic speaker, which has a 2250-ohm field coil. The No. 32 chassis contains a tone control which is not incorporated in the No. 30 model. This tone control consists of a 50,000-ohm variable resistor in series with a .04 condenser connected between the plate terminal of the resistance coupler and the grounded chassis. Volume in both chasses is controlled by regulating the screen grid voltage of the three R.F. tubes by means of a 10,000-ohm potentiometer connected across a section of the 5000-ohm bleeder resistor.

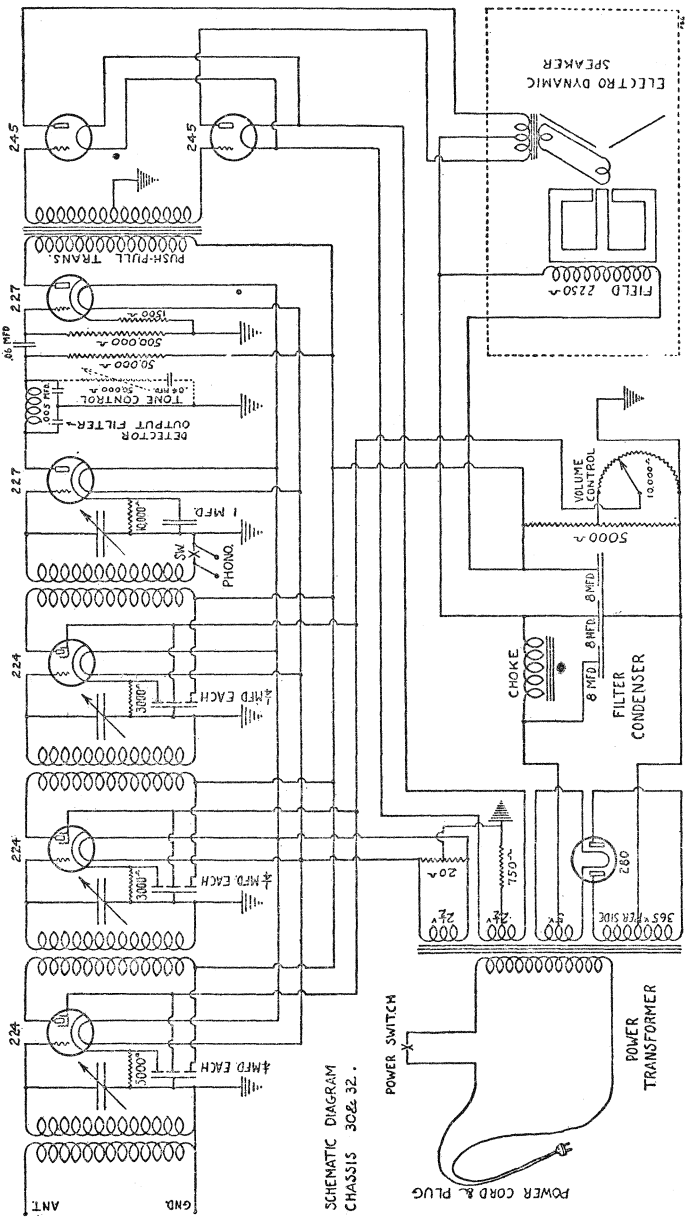
General testing of all voltages, continuity of circuits and parts is easily done by turning the chassis bottom up, when all wiring and parts terminals are readily accessible. The electrolytic filter condenser and an open-frame type power transformer are enclosed by the shield on the right-front corner of the base. The position and lengths of all wiring leads in the set are arranged to give most stable operation, and hence none must be altered or else the efficiency might be reduced or oscillation encouraged. In case of trouble inspect the wiring, resistors and other parts for burn-outs, grounds, and short-circuits. Check the socket spring clips for faulty or open connections to the tube prongs. Filament contacts especially should be very firm, as they carry considerable current. The A, B, and C voltages can be measured with a set analyzer or with a high resistance voltmeter when the chassis is inverted. The plate voltages of the R.F. detector and 1st audio tubes are measured from the socket cathode terminal to the plate terminal, but of the power tubes it is measured from either filament terminal to the plate terminal. C-bias voltages of the R.F. and 1st audio tubes are measured from the socket cathode terminal to the ground of each socket.

In case of oscillation note first if a good ground connection is used and if all tube shields are firmly in place. Test the R.F. tubes. Also check the line voltage to make sure that it is not excessively high. See that no wiring has been moved seriously from its proper place. It may be that the detector output filter is defective and a new one may be tried. With the set operating and oscillating, check each bypass condenser with a pair of test leads connected to a 1-mfd. condenser by testing from ground near tuning condenser bolts to each cathode terminal, each screen terminal, and each R.F. pos. B terminal. Lower screen voltages will stop oscillation, and a tap on the voltage divider is provided for this purpose. Replacing one or several of the R.F. tube biasing resistors with units of slightly higher value may stop oscillation. But never change the value of the detector biasing resistor. If it is necessary to replace a defective coil, install an entire new set so that all will be properly matched.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Screen Volts
1st R.F.	224	2.3	160	3.5	60
2nd R.F.	224	2.3	160	3.5	60
3rd R.F.	224	2.3	160	3.5	60
Detector	227	2.3	125	10.0	—
1st A.F.	227	2.3	155	9.0	—
Output	245	2.3	230	45.0	—

KENNEDY MODELS 30 AND 32



SPARTON RECEIVERS—GENERAL INFORMATION

All Sparton receivers employing the Equasonne circuit utilize a series antenna trimmer and a double dual-tuned input or preselector circuit. A 4-gang tuning condenser is used, the last three sections of which are provided with a trimmer or balancing condenser. To balance a receiver connect a 0-50 D.C. voltmeter (high resistance) across the detector cathode biasing resistor; or if a set analyzer is used, insert the plug into the detector socket and set the meter to indicate cathode volts. Tune in a station at about 1000-cycles or above and with the volume control full on adjust the antenna condenser screw to the right or left until the highest meter reading is obtained. Then trim the balancing condensers, a special wrench being required for this work. Start with No. 3 (the one farthest from the antenna post or at the extreme right) and turn it to the right or left until the highest meter reading is obtained. Then adjust trimmers No. 1 and No. 2 respectively. Be sure to follow the order suggested here. When making these adjustments, use about ten feet of antenna wire if a local station is used and the regular antenna if a distant station.

In all Sparton receivers there are only two connections between the preselector and radio frequency amplifier, and these are made with small pin jacks. To reach these pin jacks, it is necessary to unbolt the tuning unit from the wooden base board, and the unit can then be moved away from the amplifier. If the volume is poor, reception noisy, or the signals fade, these pin jack connections should be inspected and if necessary cleaned with fine sandpaper.

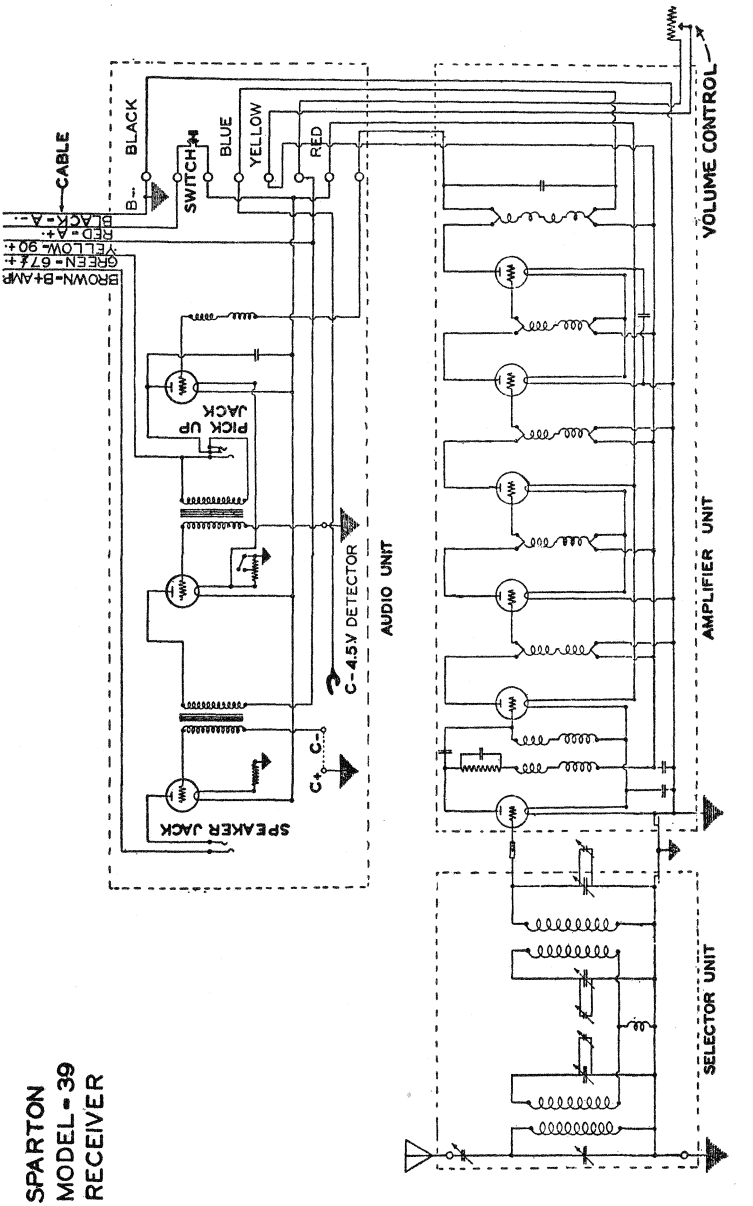
CARBON TUBES USED IN SPARTON RECEIVERS

Type No.	Fil. Volts	Fil. Amps.	Plate Volts	Plate Mill's	Grid Volts	Plate Imp.	Mut. Con.	Amp. Fac.
C-181	3	1.4	200	12	40	5000	1550	3.0
C-182	5	.9	200	18	45	2000	1400	3.0
C-585	7.5	1.25	450	55	84	1500	1750	3.8
C-181B	5	1.25	200	18	29	2400	1400	5.0
C-210	7.5	1.25	350	16	27	5500	1550	8.0
C-484	3	1.4	120	6	4	10000	1200	12.5
C-373	3	1.4	120	6	4	7000	1200	8.7
C-401	3	1.4	120	6	4	7000	1200	8.7

SPARTON MODELS 39 AND 49

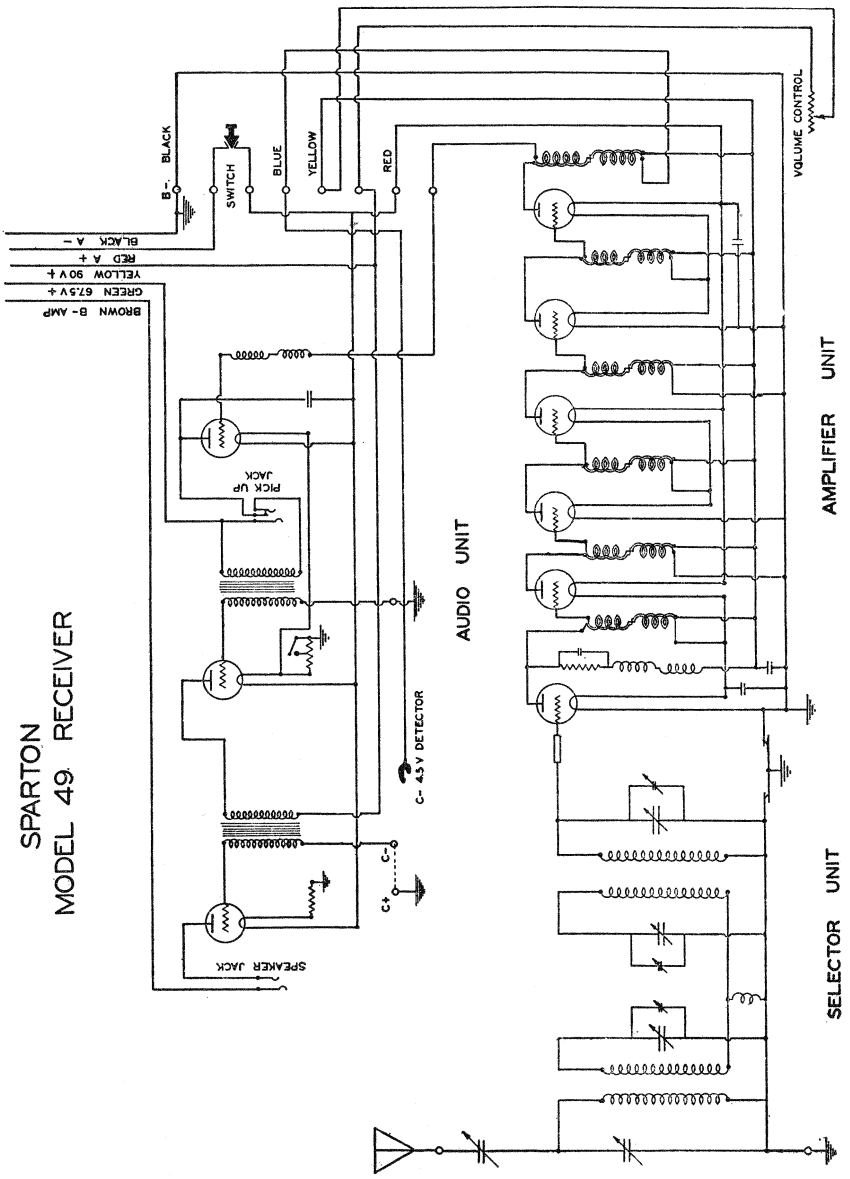
The Sparton Models 39 and 49 are 9-tube battery operated receivers employing the Equasonne circuit. The antenna is coupled to the receiver through a series trimmer. All tuning is done through a double dual-tuned preselector circuit. This is followed by six stages of untuned R.F. amplification. The detector output is amplified through two stages of transformer coupled audio amplification, the speaker being inserted into the plate circuit of the last tube with a plug and jack. The various battery voltages as well as the color code of the connecting wires are clearly indicated in the wiring diagram. In the R.F. amplifier the tubes are arranged into pairs, each pair having the filaments in series and connected across the six-volt battery line. Six tubes of the 686 type are used. In the detector and first audio stage standard 201A type tubes are used, and in the output a 171A type tube.

SPARTON MODEL 39



SPARTON
MODEL - 39
RECEIVER

SPARTON MODEL 49



SPARTON MODEL A.C. 89

The Sparton Model A.C.-89 is an 8-tube receiver employing the Equasonne circuit. It utilizes a double dual-tuned selector system (also known as a band-pass tuner) ahead of the first R.F. tube. This is followed by five stages of untuned R.F. amplification that feeds into a grid bias detector. Cardon tubes of the C-484 type are used in the R.F. and detector stages. The detector in turn feeds directly into a power audio stage employing a C-585 tube, which corresponds to the familiar type 250 power tube with a 7½-volt filament. The antenna is coupled to the input tuner through a small trimmer condenser that is mounted at the side of the chassis. This trimmer must be set correctly when the receiver is installed or whenever any changes are made in the antenna system. To adjust the trimmer, tune in a station near the center of the dial, turn down the volume until the station can just be heard, and then set the condenser for loudest reception. Volume is controlled through a 15,000-ohm variable resistor in series with a 110-ohm cathode biasing resistor for the five R.F. tubes. The magnetic cone speaker is connected through an output filter consisting of a 30-henry choke and a 2-mfd blocking condenser across the plate of the output power tube and the center tap on the filament circuit. The grid of the power tube is biased through a 1250 ohm resistor connected between the ground and the center tap on the filament winding.

A phonograph pick-up jack is also provided in the input circuit of the detector tube. The connections are arranged so that when the phonograph plug is inserted the grid is disconnected from the R.F. amplifier and connected to one side of the pick-up. The other side of the pick-up is connected to the cathode. At the same time the 20,000-ohm resistor is shunted by a 1000-ohm unit, which reduces the combined resistance to about 950 ohms, and thus changes the bias of the tube so that it operates as an amplifier instead of a detector.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st R.F.	C-484	3.0	128	9	7
2nd R.F.	C-484	3.0	158	9	7.8
3rd R.F.	C-484	3.0	158	9	5.5
4th R.F.	C-484	3.0	158	9	7.9
5th R.F.	C-484	3.0	158	9	7.4
Detector	C-484	3.0	220	10	1.7
Audio	585	7.4	220	38	25.0
Rectifier	280	5.1	—	—	28

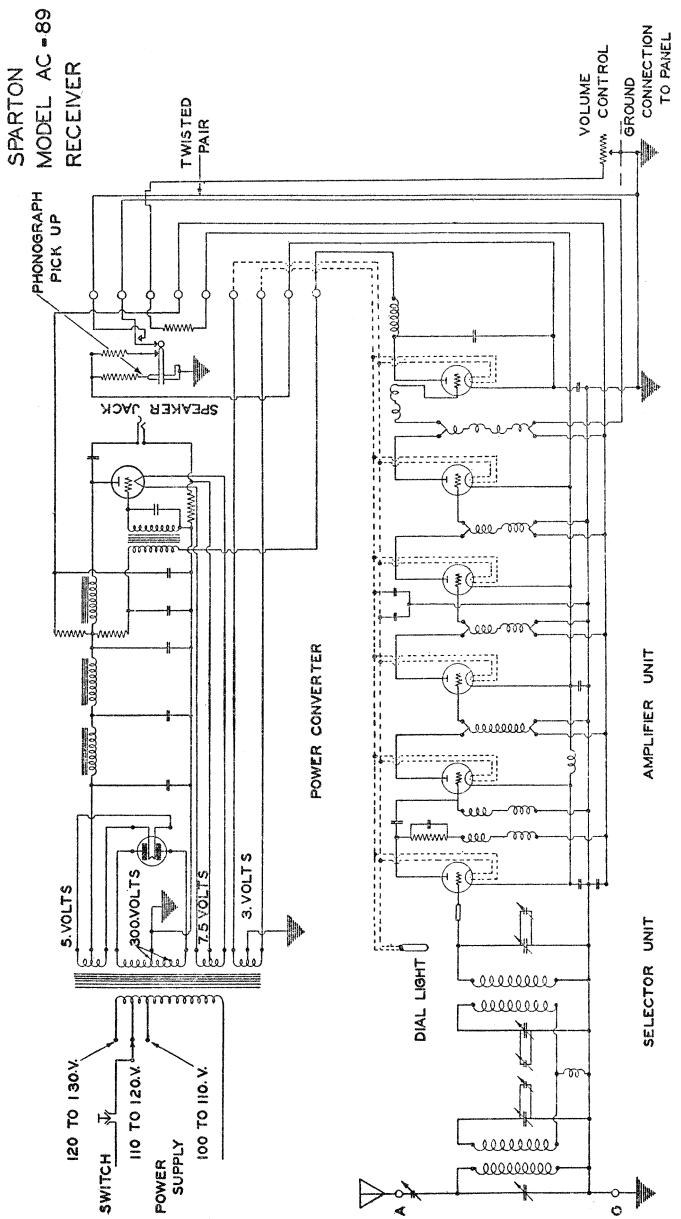
SPARTON MODEL 89A

The Sparton Model 89A employs practically the same circuit arrangement as the A.C. 89. A dynamic speaker is used, however, and in order to be able to supply sufficient exciting current to the speaker field two type 281 rectifier tubes are used. The field coil is connected in series with the R.F. plate circuit and thus serves as a filter and voltage reducing resistor.

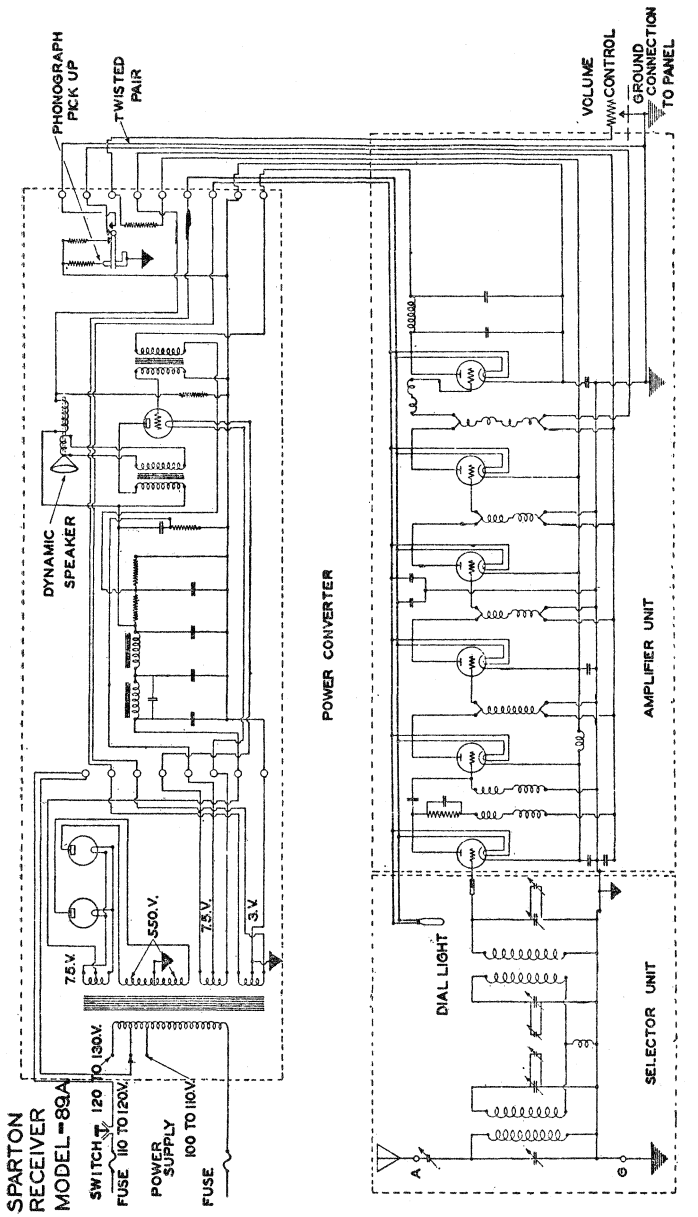
TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stages	484	3.	120	9	7.
Detector	484	3.	240	25	1.5
Audio	585	7.4	380	62	52.
Rectifier	281	7.4	—	—	58.

SPARTON MODEL A. C.—89



SPARTON MODEL 89A



SPARTON MODEL 109

The Sparton Model 109 is a 10-tube A.C. receiver employing the Equasonne circuit. It is built up in four separate but interconnected units. The antenna is coupled to the receiver through a small series condenser that must be properly set when the receiver is installed or whenever any change is made in the antenna circuit. All tuning is done through a double dual-tuned input or preselector circuit, and this is followed by five stages of untuned R.F. amplification using aperiodic (broadly resonated) R.F. transformers. The first transformer has in series with its primary a 2800-ohm resistor shunted by a .0001-mfd. condenser. The detector is of the grid bias type with its cathode biased through a 20,000-ohm resistor bypassed by a 1-mfd condenser. Tubes of the 484 type are employed in the R.F. and detector stages. The cathodes of the R.F. tubes are biased through a 110-ohm fixed resistor in series with a 50,000-ohm variable resistor which serves as a volume control. Two condensers of 1-mfd each bypass this R.F. cathode circuit to ground. Another .25-mfd condenser bypasses the R.F. plate circuits to ground. A single power audio stage is used with two type 585 tubes in push-pull, the grids of these tubes being biased to ground through a 900-ohm resistor. A phonograph jack is provided in the detector input circuit. The connections are arranged so that when the plug is inserted the grid is disconnected from the R.F. amplifier and connected to one side of the pick-up. The other side of the pick-up is connected to the cathode. At the same time the 20,000-ohm resistor is shunted by a 1000-ohm unit, which reduces the combined resistance to about 750-ohms, and thus changes the bias so that the tube operates as an amplifier instead of a detector. The field of the dynamic speaker is connected in series with the R.F. plate circuit and serves as a reducing resistor.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st R.F.	484	3.0	120	9	4.3
2nd R.F.	484	3.0	122	8	6.5
3rd R.F.	484	3.0	122	8	8.0
4th R.F.	484	3.0	122	8	6.5
5th R.F.	484	3.0	120	8	6.3
Detector	484	3.0	185	32	3.8
Audio	585	7.7	340	65	55
Rectifier	281	7.7	—	—	68

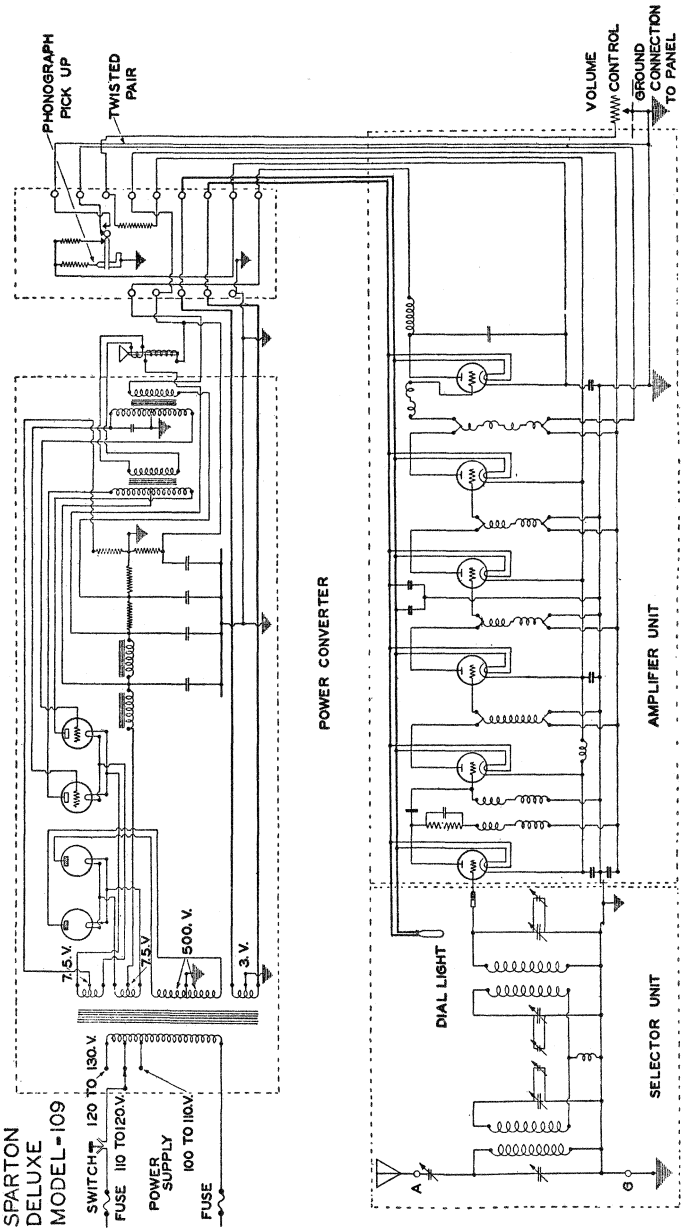
SPARTON MODEL 110

The Sparton Model 110 is a 12-tube circuit and is the same as the Model 109 as far as the tuning system, R.F. amplifier and detector circuits are concerned. It differs in that it has a first audio stage using two type 226 tubes in push-pull followed by a second push-pull stage with two type 250 tubes. The remainder of the audio and power circuit is of standard construction, and the values of all resistors and condensers are clearly indicated in the circuit diagram.

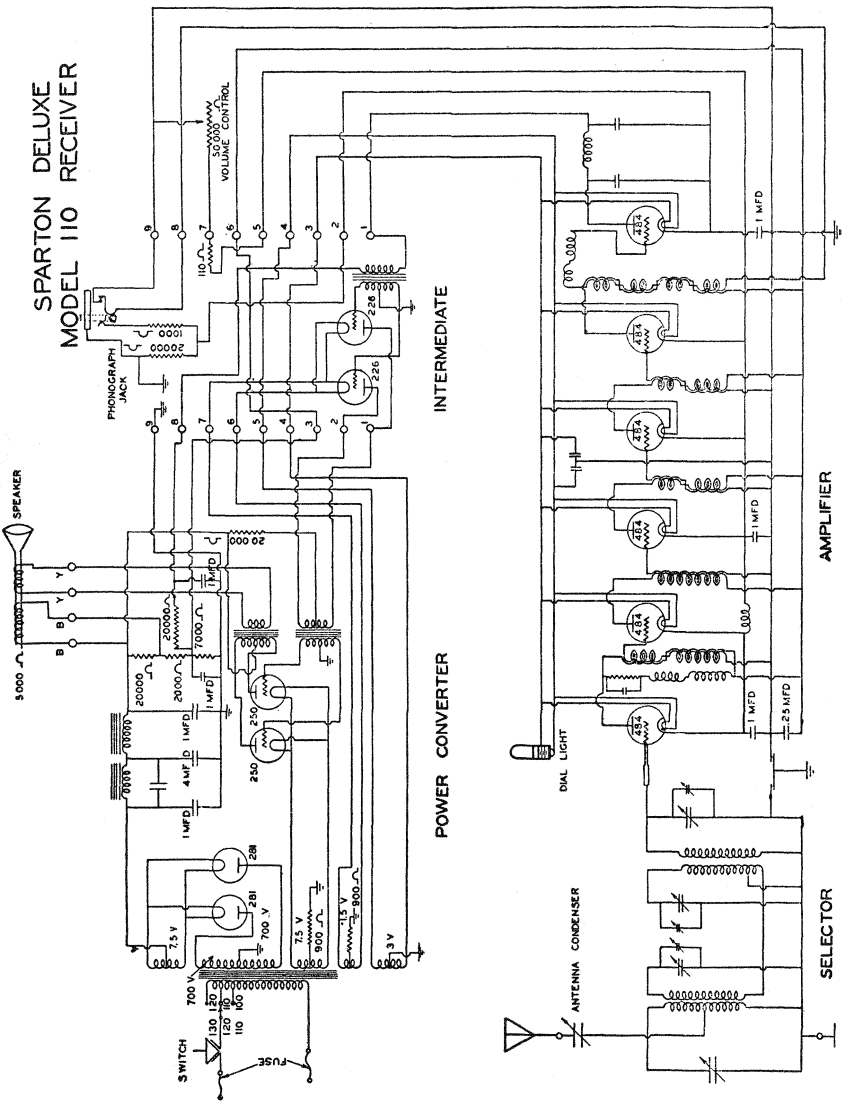
TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stages	484	2.9	120	4.5	7.5
Detector	484	2.9	110	10.	1.0
1st Audio	226	1.3	260	20.	10.0
2nd Audio	250	7.3	475	80.	70.0
Rectifier	281	7.3	—	—	95.0

SPARTON MODEL 109



SPARTON MODEL 110



SPARTON MODELS 931 AND 301 D.C.

The Sparton D.C. Models 931 and 301 are designed for operation from a 115-125 volt D.C. line and employ the familiar Equasonne circuit. All tuning is done through a double dual-tuned input or band-selector circuit. This is followed by five stages of untuned R.F. amplification using aperiodic (broadly resonated) R.F. transformers. The first R.F. transformer differs somewhat and has in series with its primary a 2800-ohm resistor shunted by a .0001-mfd. condenser. The detector is of the grid bias type and has its cathode biased through a 20,000-ohm resistor to ground. Tubes of the 484 type are used in the R.F. and detector stages. A single power audio stage is used with two type 182 tubes in push-pull. Suitable bypass condensers are used in the various plate and cathode circuits, all values being clearly indicated in the circuit diagram. The grids of these power tubes are biased through a 22½-volt C-battery. The cathodes of the five R.F. tubes are biased through a 40-ohm fixed resistor in series with a 50,000-ohm variable resistor, the latter serving as a volume control.

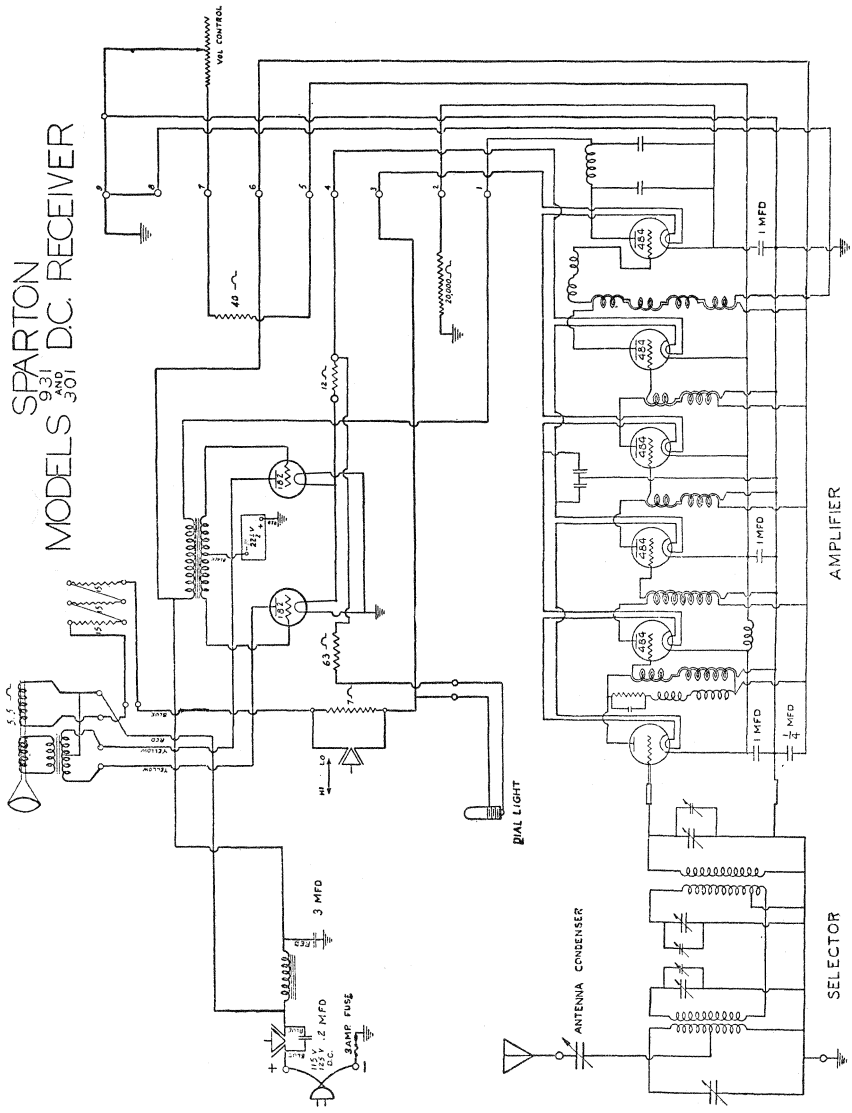
The power supply system is arranged to be connected directly to the D.C. lighting circuit. The negative side of the line is grounded to the metal chassis, and of course the plug must be inserted properly for should the line plug be inserted incorrectly and the receiver will not function. No ground connection must be made to the set, or should the line plug be inserted incorrectly and the receiver be grounded, a direct short circuit would be set up since the negative side of the line is grounded at the power house. A 3-ampere fuse connected into the negative line serves as a safety guard in case an error is made. The "on-off" switch is shunted by a 0.2-mfd. condenser to absorb any flashes that might occur when circuit is opened.

The positive side of the line divides, and one branch leads through a choke coil (shunted by a 3-mfd. condenser) to the plate circuits of the R.F. and detector tubes. The other branch leads through the dynamic speaker field and three 15-ohm resistors in series to the filament circuits of the tubes. A tap is taken off at the high potential side of the speaker field and connected to the center tap of the output transformer for supplying plate current to the output power tubes. An extra 7-ohm resistor is also in the filament circuit shunted by a "Hi-Lo" short-circuiting switch. When the line voltage is low, the switch is in, while when the line voltage becomes too high—115 volts or more—the switch is out so that the additional resistance is cut into the circuit. A dial light in series with a 63-ohm resistor is connected in parallel with the filament circuit of the R.F. and detector tubes. If one of these tubes burns out, the dial light acts as a fuse and also will burn out. Hence, a burnt out dial light generally is an indication that there is a faulty filament circuit. Often a break in the filament circuit is caused by a defective 15-ohm resistor, and therefore these resistors should receive first attention in case of trouble. Also, none of these tubes should ever be removed from their sockets without first disconnecting the set from the power line. A 3.8-volt Mazda 13, type G3 lamp is used as a dial light.

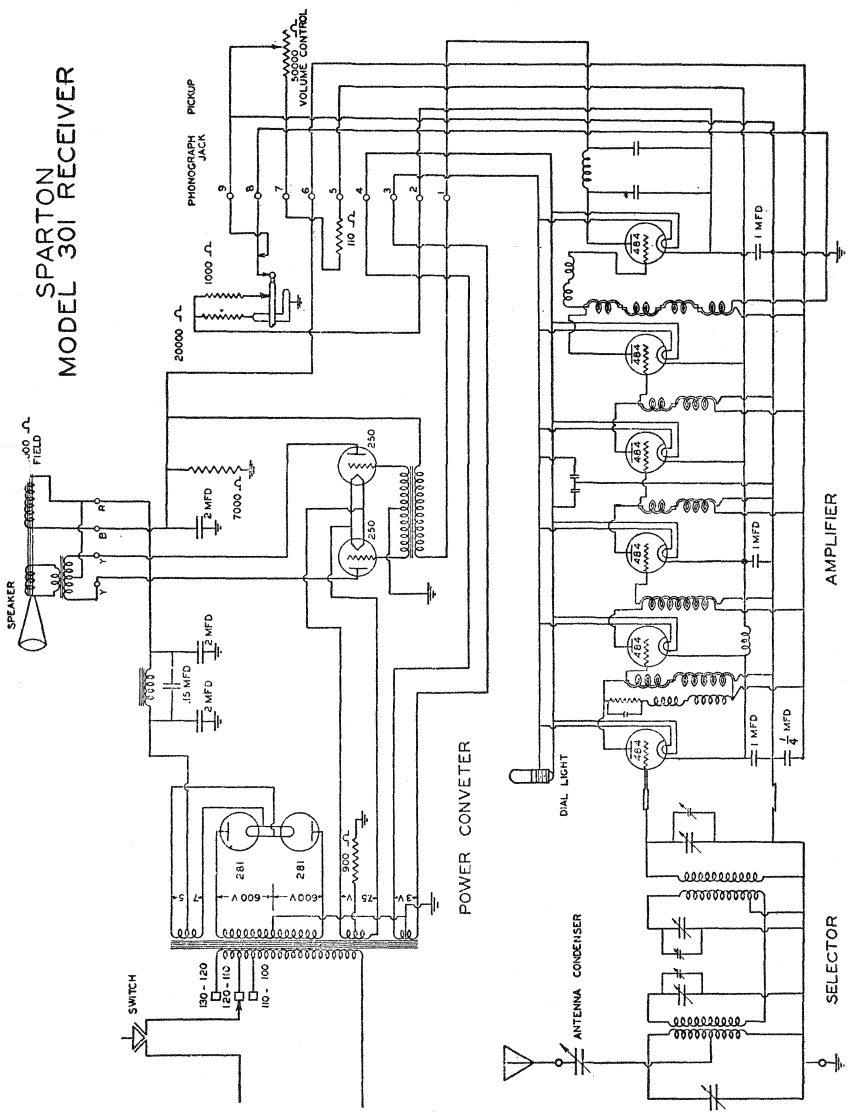
TUBE SOCKET VOLTAGES

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts
1st R.F.	484	3	112	2.5
2nd R.F.	484	3	112	2.5
3rd R.F.	484	3	112	2.5
4th R.F.	484	3	112	2.5
5th R.F.	484	3	112	2.5
Detector	484	3	106	9.0
Audio	182	4.5	115	22.5
Audio	182	4.5	115	22.5

SPARTON MODELS 931 AND 301—D. C.



SPARTON MODEL 301



THE SPARTON MODEL 930

The Sparton Model 930 is a 9-tube A.C. receiver employing the Equasonne circuit. It is built up in three separate but interconnected units—the selector unit, amplifier unit, and power converter. The antenna is coupled to the receiver through a small series condenser that must be properly set when the receiver is installed or whenever any change is made in the antenna circuit. All tuning is done through a double dual-tuned input or preselector circuit, and this is followed by five stages of untuned R.F. amplification using aperiodic (broadly resonated) R.F. transformers. The first transformer has in series with its primary a 2800-ohm resistor shunted by a .0001-mfd. condenser. The detector is of the grid bias type with its cathode biased through a 20,000-ohm resistor bypassed by a 1-mfd condenser. Tubes of the 484 type are employed in the R.F. and detector stages. The cathodes of the R.F. tubes are biased through a 110-ohm fixed resistor in series with a 50,000-ohm variable resistor which serves as a volume control. Two condensers of 1-mfd. each bypass this R.F. cathode circuit to ground. Another .25-mfd. condenser bypasses the R.F. plate circuits to ground. A single power audio stage is used with two type 182 tubes in push-pull, the grids of these tubes being biased to ground through a 1250-ohm resistor. A phonograph jack is provided in the detector input circuit. The connections are arranged so that when the plug is inserted the grid is disconnected from the R.F. amplifier and connected to one side of the pick-up. The other side of the pick-up is connected to the cathode. At the same time the 20,000-ohm resistor is shunted by a 1000-ohm unit, which reduces the combined resistance to about 750-ohms, and thus changes the bias so that the tube operates as an amplifier instead of a detector.

In the power supply system a type 280 full wave rectifier is used and a single heavy duty filter choke. A 2500-ohm dynamic speaker is used with the output transformer built into the speaker. The field is used both as a filter and voltage reducing resistor in the plate circuit of the R.F. tubes.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
1st R.F.	484	3	105	4	6.2
2nd R.F.	484	3	125	4	5.0
3rd R.F.	484	3	125	4	6.7
4th R.F.	484	3	125	4	7.6
5th R.F.	484	3	125	4	6.8
Detector	484	3	170	17	1.1
Audio	182	5	190	38	16
Audio	182	5	190	38	16
Rectifier	280	5	—	—	37

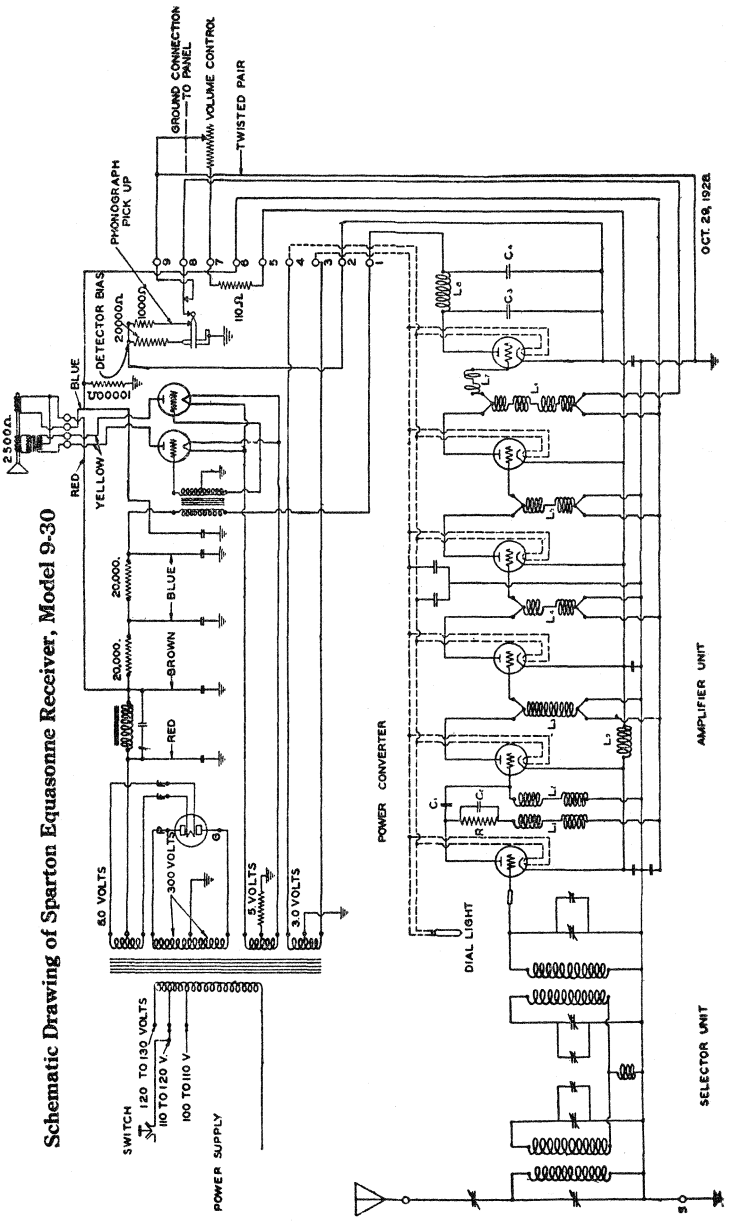
SPARTON MODEL 931

The Model 931 chassis employs practically the same circuit diagram as the 930, and differs in that an electrolytic condenser is used in the filter circuit instead of a paper condenser as was formerly used.

TUBE VOLTAGES AT 120 VOLTS LINE PRESSURE

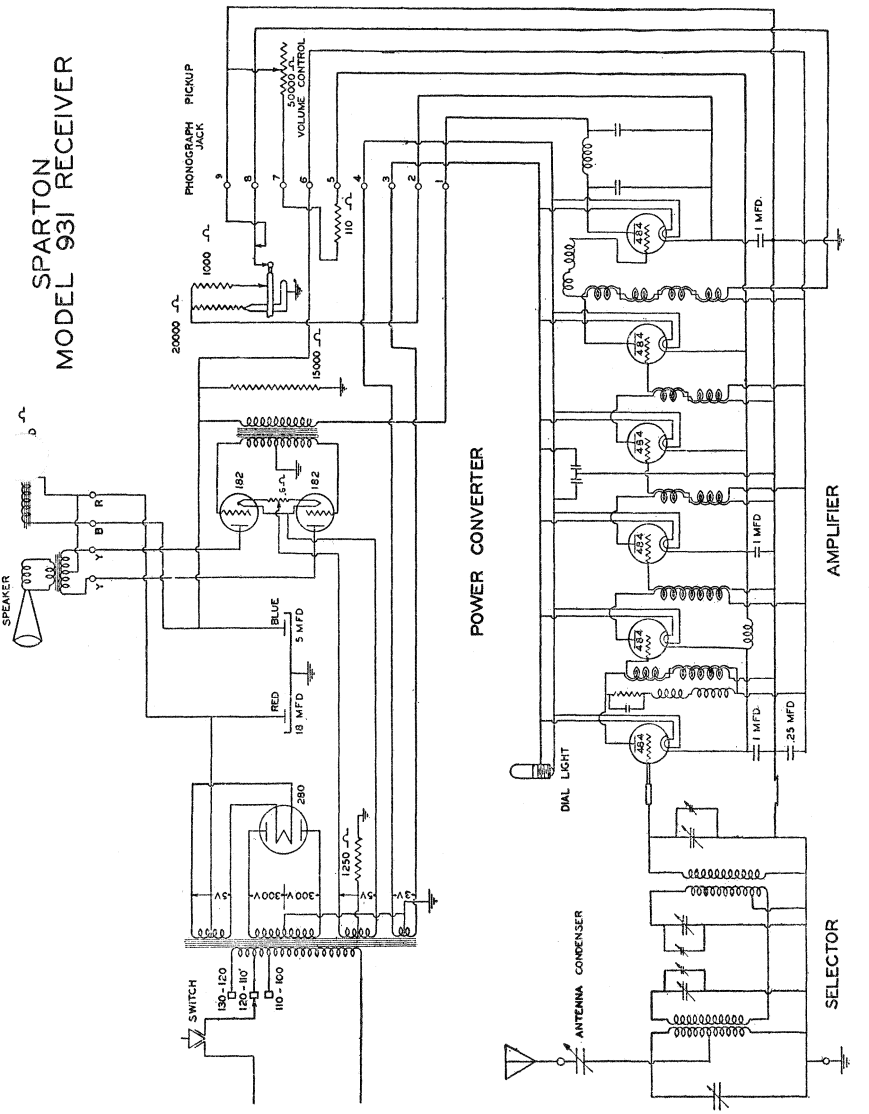
Position of Tube	Type Tube	Fil. Volts	Plate Volts	Grid Volts	Plate Mill's.
R.F. Stages	484	2.9	120	4.5	7.5
Detector	484	2.9	110	10.	1.
Audio	182	4.9	270	35.	25.
Rectifier	280	5.0	—	—	85.

SPARTON MODEL 930



Schematic Drawing of Sparton Equasonne Receiver, Model 9-30

SPARTON MODEL 931



SPARTON MODEL 589

The Sparton Model 589 is a 10-tube A.C. receiver, and like the other Sparton models employs special 3-volt Cardon tubes throughout. The circuit employs a tuned R.F. stage with a type 484 tube ahead of a two-stage selector circuit (bandpass filter). This is followed by another tuned R.F. stage and four untuned stages, all with type 484 tubes. A small screw driver operated antenna condenser is used to adapt the receiver to antennas of different lengths. The advantage gained through the use of this tuned R.F. input stage is that the antenna signal current is stepped up before it is sent through the selector circuits and the sensitivity of the receiver is increased accordingly. The detector is of the grid bias type with a type 484 tube, and employs a 20,000-ohm biasing resistor between the cathode and ground. In the plate circuit is an R.F. filter consisting of a 10-millehenry choke and two .001-mfd. condensers. The detector output is fed through a standard push-pull input transformer to two type 182 B tubes. The grids of these tubes are biased through a 1250-ohm resistor connected between the center tap on the 5-volt filament winding and the ground.

The power supply system has an input transformer with a tapped primary and four secondaries, one a 3-volt filament winding for the R.F. and detector tubes, the other a 5-volt filament winding for the output power tubes, another a 5-volt winding for the filament of the rectifier tube, and a 600-volt center-tapped winding for the plate supply. A type 280 rectifier is used. In the filter circuit the speaker field, which has a resistance of 2500 ohms, is used as a single choke in connection with a 15 and 5-mfd. filter condenser. A .006-mfd. condenser is used between the ground and one side of the A.C. line to minimize any hum that might be picked up. The grid bias for the six R.F. tubes is obtained through a 110-ohm resistor connected into the common cathode line and in series with a 15,000-ohm variable resistor which serves as a volume control. Two R.F. chokes also are used in this cathode line to confine the high frequency currents to their proper paths. Suitable bypass condensers also are used as is shown in the circuit diagram. The plates of the R.F. and detector tubes are supplied from the main D.C. line after it leaves the speaker field. A 15,000-ohm bleeder resistor is also connected between this line and the ground.

A phonograph jack also is provided in the input circuit of the detector tube. The connections are arranged so that when the plug is inserted the grid is disconnected from the R.F. amplifier and connected to one side of the pick-up. The other side of the pick-up is connected to the cathode. At the same time the 20,000-ohm resistor is shunted by a 1000-ohm unit, which reduces the combined resistance to about 950 ohms and thus changes the bias of the tube so that it operates as an amplifier instead of a detector.

All tests on the set should be made with the volume control full on and the voltage adjuster connected to the proper tap. Normal filament voltage on the type 484 tubes should be 2.9 and for the 182 B tubes 4.9 volts. The normal R.F. plate pressure is 145 volts, and for the detector 140 volts without pick-up and 135 volts with pick-up. The normal detector bias is 12 volts, and with the pick-up inserted about 4 volts. The grid bias for the R.F. tubes normally is 4.5 volts. The aerial compensating condenser is set correctly by turning the volume control full on and tuning in a station at or above 1250 kilocycles and adjusting the condenser until maximum volume is obtained. On another page of this manual will be found complete technical data covering all types of Cardon tubes.

SPARTON MODEL 589